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REPORT ON EMISSIONS OF
ALDEHYDES, ORGANIC ACIDS, PARTICULATES AND HYDROCARBON SPECIES
FROM THE PRIMER PAINT BAKING OVEN AT THE GM TRUCK PLANT IN OSHAWA

ARB-TDA-20-80



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MARCH 17, 1980



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REPORT ON EVALUATION
OF ELPO OVEN EMISSIONS FROM GENERAL
MOTORS' OSHAWA TRUCK PLANT

Introduction:

As a portion of the odour survey, the Source Assessment Unit performed emission measurements on the ELPO Oven Exhaust Stacks at the GM's Oshawa Truck Plant on two occasions. The first set of measurements were performed in November, 1977, when GM was operating an Anionic ELPO System (old process). The second set of measurements were performed in July, 1979, when GM changed the anionic system to a Cationic ELPO System (new process).

Objectives:

The objectives of the survey were to gather information on odour emissions from the primer bake oven and to quantify the emissions of the probable odour causing organics, such as hydrocarbons, aldehydes, organic acids and particulates. The survey was also designed to investigate possible correlations between the odour emissions and the emissions of hydrocarbons, organic acids, aldehydes and particulates. Existence of such a correlation would aid in the development of future monitoring programmes and the assessment of abatement programmes at the automotive primer paint baking plants.

Summary:

The GM ELPO oven conversion from an Anionic to a Cationic System produced reductions in the emissions of odours,

hydrocarbons, aldehydes and organic acids. The average emission reductions were 21.8% for hydrocarbons, 24.4% for organic acids, 62.7% for aldehydes and 33.8% for odours. The most significant decrease was found in the aldehyde emissions. This is in spite of the fact that the aldehyde emissions from the old process included only three stacks and that these "three stack emissions" are compared with the emissions from all four stacks in the new process.

The results from the Cationic ELPO System (new process) indicate that there are possible correlations between hydrocarbon and odour emissions as well as the odour and aldehyde emissions. In the Anionic ELPO System (old process) no relationship between the odour emissions and the emissions of either hydrocarbons, or organic acids, or aldehydes or particulates was indicated.

Particulate emission measurements were not performed on the 'new process' (Cationic ELPO System) because of lack of correlation between the odour and particulate emissions in the 'old process' (Anionic ELPO System) and because of similar results obtained at the GM's Scarborough ELPO Oven, as described in the ORF report of 1977. Furthermore, the particulate emissions are the lowest among the emissions of the four pollutants measured from this source, and, hence, far less important in characterization of emissions from the primer paint baking ovens.

Process Description:

The primer undercoating is applied to the truck cabs by electro-deposition, which entails passing of the vehicle bodies through a tank or bath of water-based primer paint. As the cabs enter the tank on an overhead conveyer, they are charged with an anodic or

positive charge. The tank serves as the cathode, and the electrical current applied to the water-based solution causes the anionically or negatively charged paint particles to migrate to the positively charged truck cabs where they leave the solution and form a thin even coating of primer on the truck cab surface. The water and other additives are squeezed away from the primer surface during deposition, hence, the truck cabs are relatively dry upon leaving the primer tank or bath. The truck cabs are then passed through a three temperature zone oven for curing and baking of paint. This type of primer application is referred to by the automotive industry as Anionic ELPO System and henceforth shall be known as the 'old process'.

The Oshawa Truck Plant's ELPO operation was converted from an Anionic ELPO System to a Cationic ELPO System in the summer of 1979. The modifications to the process involved a complete change of coating formulation with different solid and solvent composition and a reversal of electrical charges applied to vehicle bodies and tank or bath. However, the procedure for the primer application and the equipment operation, including the primer baking oven, remained unchanged. The converted primer application process will be known as the 'new process'.

General Motors' Oshawa facilities produce only truck cabs. A truck cab has an average surface area of 39.48 m^2 . Approximately 23.66 l of ELPO primer paint is required per truck cab. In the 'old process' average truck cab hourly production rate was approximately 40 cabs, while in the 'new process' the average production rate is 45 cabs/hour.

The ELPO curing and baking oven is 86.4 m long, 3.7 m wide and 4.0 m high. It is divided into three heating or temperature

zones; Zone #1 is 16.8 m long with a temperature of 193°C, the length of Zone #2 is 35.8 m with a temperature of 193°C, and Zone #3 is 33.8 m long with a temperature of 191°C. The cab surface temperatures in all three zones are maintained at approximately 182°C. In addition to these three temperature zones there is a flash-off or reflow zone located between temperature Zone #1 and the oven entrance. The temperature of this reflow zone is maintained at approximately 48.9°C.

Each of the three temperature zones as well as the reflow zone is vented individually. Gases from Zones #1, #2 and #3 are exhausted by 214 m³/min, 184 m³/min and 190 m³/min fans respectively, through three 61 cm diameter stacks extended 11 meters above the roof line of the oven. The reflow zone is vented by a 623 m³/min fan through a 30 cm diameter stack extended 3.7 m above the roof line. Two 10 cm ports are cut at right angles to each other at approximately 6 stack diameters downstream from the fan on each of the temperature zone stacks. In addition, a third port of 5 cm in diameter, is located at approximately 15 cm above the two 10 cm ports for the measurement of hydrocarbon concentrations. A similar set of ports was cut on the reflow stack at approximately 6 stack diameters downstream of the fan. The reflow stack is capped. The locations of the stacks on the oven roof are depicted in Figure 1.

Sampling and Analytical Methodologies:

All samples from the 'old process' were collected in November 1977, while sampling of the 'new process' took place in July 1979. The measurements on each stack included the determination of odour threshold values of the exhaust gases, emission rates of

total aldehydes, organic acids, particulate (aerosol) matter and the concentrations of total hydrocarbon emissions. The total hydrocarbon concentrations were measured with an IPM Ratfisch Total Hydrocarbon Analyzer, model RS5.

All aldehyde, organic acid and particulate samples were collected with EPA Method 5 sampling trains. Both aldehyde and organic acid emission measurements were performed in accordance with the LA-APCD procedures and the Ontario Source Testing Code. The aldehyde and organic acid samples from the 'old process' (November 1977) were analyzed by Nucro-Technics Limited. Their report can be found in Appendix A. The analyses of the aldehyde and organic acid samples from the 'new process' (July 1979) were performed by the Ontario Research Foundation (O.R.F.). Their report can be found in Appendix C.

The particulate matter from tests in November, 1977, was weighed by the Source Assessment Unit; details are outlined in Appendix B. No particulate determination was performed on the 'new process' (July, 1979) due to the fact that low emission rates were determined for the 'old process' and because of a lack of any correlation between the particulate emission rate and the odour threshold values.

Predilution was employed in the collection of odour samples to prevent condensation, which may cause lowering of the odour intensity upon sample storage. The odour samples were collected in pre-conditioned tedlar sampling bags and evaluated by an odour panel consisting of a minimum of six members. Both prediluted and unprediluted odour samples were collected at each source. The predilution gas employed was bottled nitrogen, which is inert and which may have helped in hindering oxidation on storage. The predilution

ratio for the 'old process' was 5:1. These samples were evaluated by the Source Assessment Unit using an IIT Research Institute's Dynamic Triangle Olfactometer and following the Dravniek (Dynamic Dilution) evaluation procedures. The predilution ratio employed for the 1979 samples was 4.7:1 for the high temperature zone stacks and 3.3:1 for the reflow stack. These samples were evaluated by O.R.F., employing a dynamic dilution system of their own design and following a modified Dravniek odour panel evaluation procedure. Details of these evaluations can be found in Appendix B.

Results and Discussion:

Odour Emissions:

Odour threshold values and emission rates are tabulated in Tables 1 and 2 for the 'old' and 'new process' respectively. Table 3 compares the odour threshold values between the 'old process' and the 'new process'; from this table it is noted that in the 'old process' an average odour threshold value per stack is 3691 o.u. (odour units) while in the 'new process' the average odour threshold value per stack is 2653 o.u. This represents a reduction of approximately 28% in the average odour emissions between the 'old' and 'new process' (O.R.F. found approximately 48% in overall odour reduction at GM's Scarborough facilities¹). From the same table (3) it can be noted that the odour threshold reductions are not uniform from stack to stack. Odours in stacks #2 (heating zone #2) and #4 (reflow) have increased; in the case of stack #4 the exhaust gases from the 'new process' have almost double odour threshold compared to the gases from the 'old process'. At GM's Scarborough plant, O.R.F. found an increase in the odour threshold value at the reflow stack (stack #1), but that increase was much lower (7.5%) than in the measurements at the Oshawa plant. Also,

O.R.F. did not observe any increase in odour emissions from any of the heating zone stacks of the Scarborough oven. Possible explanation for these discrepancies could be sought in slightly different designs of the two ovens. The Scarborough oven is approximately 10 meters longer than the Oshawa oven and it has five heating zones as compared to Oshawa oven's three heating zones. Furthermore, all five heating zones of the Scarborough oven are heated to 171°C. These design differences could also explain the lower odour emission reduction from the Oshawa truck plant oven upon paint change, as compared to the Scarborough van plant.

Comparison of odour emission rates from the 'old' and 'new process' in the Oshawa plant is illustrated in Table 4. It is noted that the trend in the emission rates follows the trend in the odour threshold. The overall reduction in the odour emission rate from the oven, achieved by switching the two ELPO processes is approximately 34%.

Hydrocarbon Emissions:

The hydrocarbon emissions can be found in Tables 5 and 6 for the 'old' and 'new process' respectively. The comparisons of corresponding emission rates and concentrations for the 'old process' and the 'new process' are shown in Tables 7 and 8 respectively. From Table 7, an average hydrocarbon concentration per stack is 164.93 ppm for the 'old process' and 113.24 ppm for the 'new process', hence, there is a reduction of approximately 31% in the 'new process'. The average hydrocarbon concentration reduction is of the same order of magnitude as the average odour threshold values reduction. However, the characteristics of reduction for the

individual stacks are different; hydrocarbon concentrations in stacks #2, #3 and #4 have been reduced while in stack #1 there was a 68.8% increase in total hydrocarbon concentrations. Hence, it may be concluded that the percentages of the overall reductions in the emissions of both odours and hydrocarbons are of very similar magnitudes, but there is no correlation in the measurements at the individual stacks.

The decreases in hydrocarbon emission rates from individual stacks (Table 8) have the same characteristics as hydrocarbon concentrations. However, the order of magnitude of percent reductions are different for different stacks; in stacks #2 and #3 these reductions are similar and in the order of 20%, while in stack #4 the emission rate was decreased by more than approximately threefold.

The odour threshold values and hydrocarbon concentrations versus stack numbers are plotted on Figures 2 and 3. It is observed from Figure 2 that hydrocarbon concentrations do not correlate with the odour threshold values from stack to stack in the 'old process'. However, Figure 3 shows that the hydrocarbon concentrations and odour threshold values in the 'new process' display the same general trend; although the sharpness of the hydrocarbon concentrations peak is less pronounced than the odour threshold values peak. The plots for odour emission rates and hydrocarbon emission rates versus stack numbers can be found on Figures 9 and 10. From Figure 9, again no correlations were found between hydrocarbon and odour emission rates in the 'old process', but the 'new process' (Figure 10) displays similar results as the hydrocarbon concentrations and odour threshold values. Hence, it may be concluded that there is a possible correlation between the odour and hydrocarbon emissions from the 'new process'.

Aldehyde Emissions:

The aldehyde emission rates and concentrations in the 'old' and 'new process' are depicted in Tables 9 and 10 respectively. No aldehyde emission rates and concentrations were established for stack #4 (reflow) from the 'old process' because of interfering species in the sample of stack gas. It is suspected that the aldehyde emissions from this source would be low as indicated by the results from the Scarborough oven (O.R.F. Report)¹.

The comparisons of aldehyde concentrations and emission rates between the 'old' and 'new process' are tabulated in Tables 11 and 12 respectively. Again, the average oven emission comparisons are based on three stacks for the 'old process' and four stacks for the 'new process'. The per stack average aldehyde concentrations were 14.035 ppm for the 'old process' and 7.633 ppm for the 'new process'. Although the average aldehyde concentration for the 'old process' is the average of three stacks, it is still almost double the average concentration of the 'new process' (Table 11). A similar percentage of reduction (approximately 63%) is found in the average aldehyde emission rates between the 'old process' and the 'new process' (Table 12). Average aldehyde emission rates per stack of 0.217 kg/hr for the 'old process' and 0.081 kg/hr for the 'new process' were observed.

The odour thresholds and aldehyde concentrations versus stack numbers are plotted on Figure 4 for the 'old process' and on Figure 5 for the 'new process'. There are no indications of any correlations between odour thresholds and aldehyde concentrations in the 'old process'. There are, however, strong similarities between the odour thresholds and aldehyde concentrations for the 'new process' (Figure 5). The odour thresholds and aldehyde concentrations curves display the same general characteristics, with the aldehyde's point

of maximum being much lower than that of odour's.

The aldehyde emission rates and odour emission rates for the 'old' and 'new process' are plotted on Figures 11 and 12 respectively. No correlation between these two pollutants in the 'old process' is indicated (Figure 11). On Figure 12, the curves for odour emission rates and aldehyde emission rates are almost identical, hence, an indication that correlation between these two pollutants from the 'new process' may exist.

Organic Acid Emissions:

The emission rates and concentrations of organic acids are found on Tables 13 and 14 for the 'old' and 'new process' respectively. The comparison of organic acid concentrations and emission rates for the 'old' and 'new process' are shown in Tables 15 and 16 respectively. A per stack average organic acid concentration in the 'old process' was 96.06 ppm while in the 'new process' this concentration was 74.47 ppm. This indicates that the 'new process' has reduced its per stack average organic acid concentration by approximately 22% (Table 15). From the same Table, it is observed that similar reductions were observed in all heating zone stacks, except for Stack #4 (reflow), where organic acid concentration was increased by approximately 10%. It is observed from Table 16 that the 'old process' has an average organic acid emission rate of 2.09 kg/hr per stack while the 'new process' has a per stack average emission rate of 1.58 kg/hr. This indicates that the 'new process' has reduced the average organic acid emission rate by approximately 24%. From the same Table it is noted that there is a reduction in emission rates from all four stacks. The range of reduction is between 13 to 30.8%. However, the reduction trend in

organic acid emission rates deviates from the organic acid concentrations in that in Stack #4 there was an increase in concentration.

A possible explanation is that the exhaust gas volume for Stack #4 in the 'new process' is lower than the 'old process', hence a reduction in the emission rate from the 'new process'.

The odour threshold values and organic acid concentrations versus stack numbers are plotted on Figures 6 and 7 for the 'old' and 'new process' respectively. Both plots indicate that there is no correlation between the odour threshold values and the organic acid concentrations. Plots of odour emission rates and organic acid emission rates versus stack numbers for the 'old' and 'new process' respectively, are shown in Figures 13 and 14. The curves on these two graphs are similar, which indicates that there are no correlations between odour emission rates and organic emission rates in either the 'old' or the 'new process'.

Particulate (Aerosol) Emissions:

The concentrations and emission rates of particulates for the 'old process' are tabulated on Table 17. From this table, it is observed that the ELPO oven has an average stack particulate emission rate of 0.025 kg/hr and a per stack average particulate concentration of 3.061 mg/m³. These are the lowest emission rates and concentrations of the four pollutants measured at this source (old process).

The particulate concentrations and odour concentration versus stack numbers are plotted on Figure 8. This graph indicates that the trend of the particulate and odour concentrations are dissimilar and almost mirror images of each other. Similar characteristics are displayed by the curves of particulate emission rates

versus stacks and odour emission rates versus stacks (Figure 15). Hence, it may be concluded that the odour emission rates do not correlate with the particulate emission rates nor do odour threshold values correlate with the particulate concentrations.

Due to the lack of correlations of the odour and particulate emissions (O.R.F. also indicated the same results for the GM Scarborough oven¹) and the low emissions for particulate from this source, it was decided to omit the particulate emission determinations from the July 1979 (new process) emission measurement programme.

Conclusions:

1. Change from anionic to cationic ELPO process resulted in reduction of odour emissions. This reduction was 34% in terms of actual odour discharge per unit time from the oven. However, if the odour discharge is expressed per unit production the reduction per cab is approximately 38%.
2. Similarly, emission reductions were observed for all chemical species measured in this sampling programme. The percent reduction varies depending on species and for total hydrocarbons it was 21.8%, for aldehyde 62.7% and for organic acids 24.4%.
3. Attempts to correlate the concentrations of chemical species measured in each stack with the corresponding odour strength met with mixed success; total hydrocarbons and total aldehydes exhibited possible correlation with odours while organic acids and particulates indicated no such correlation.

Reference:

1. O.R.F. Report 77-02 'Evaluation of ELPO Oven Emissions (Proposal P-2528/G) for Air Resources Branch, Ministry of the Environment, Toronto, Ontario, and General Motors of Canada Limited, Scarborough, Ontario.

Table 1:
Odour Threshold Values and Emission Rates (Old Process)

STACK #	DATE	PREDILUTION RATIO	ODOUR THRESHOLD (o.u.*)	EMISSION RATE o.u./min x 10 ⁶
1	Nov. 15, 1977	0	306	1.68
	Nov. 17, 1977	5:1	2460	13.50
2	Nov. 9, 1977	0	271	1.42
	Nov. 9, 1977	5:1	3414	17.93
3	Nov. 16, 1977	0	1845	10.14
	Nov. 16, 1977	5:1	8018	44.05
4	Nov. 8, 1977	0	119	0.28
	Nov. 8, 1977	5:1	873	2.08

* o.u. $\equiv$ one volume unit of the odourous gas diluted with x volume units of odourless air to reach the panel odour threshold value at which 50% of the panelists would not detect an odour. By convention, volume units are measured in cubic feet.

Table 2:

Odour Threshold Values and Emission Rates (New Process)

STACK #	DATE	PREDILUTION RATIO	ODOUR THRESHOLD (o.u. *)	EMISSION RATE o.u*/min x 10 ⁶
1	July 4, 1979	0	289	1.61
	July 4, 1979	4.7:1	1939	10.83
2	July 3, 1979	0	657	3.38
	July 3, 1979	4.7:1	4573	23.54
3	July 4, 1979	0	410	2.30
	July 5, 1979	4.7:1	2437	13.68
4	July 5, 1979	0	604	1.20
	July 5, 1979	4.7:1	1662	3.29

* o.u. $\equiv$ one volume unit of the odourous gas diluted with x volume units of odourless air to reach the panel odour threshold value at which 50% of the panelists would not detect an odour. By convention, volume units are measured in cubic feet.

Table 3:

Comparison of Odour Threshold Values

STACK #	ODOUR THRESHOLD VALUES (ou*)		PERCENTAGE CHANGE
	OLD PROCESS	NEW PROCESS	
1	2460	1939	- 21.2
2	3414	4573	+ 34.0
3	8018	2437	- 69.6
4	873	1662	+ 90.4
Average	3691	2653	- 28.1

* ou $\equiv$ one volume unit of the odourous gas diluted with x volume units of odourless air to reach the panel odour threshold value at which 50% of the panelists would not detect an odour. By convention, volume units are measured in cubic feet.

Table 4:
Comparison of Odour Emission Rates

STACK #	ODOUR EMISSION RATES (ou*/min x 10 ⁻⁶)		PERCENTAGE CHANGE
	OLD PROCESS	NEW PROCESS	
1	13.50	10.83	- 19.8
2	17.93	23.54	+ 31.3
3	44.05	13.68	- 68.9
4	2.08	3.29	+ 58.2
Average	19.39	12.84	- 33.8

* ou ≡ one volume unit of the odourous gas diluted with x volume units of odourless air to reach the panel odour threshold value at which 50% of the panelists would not detect an odour. By convention, volume units are measured in cubic feet.

Table 5:

Hydrocarbon Concentrations and Emission Rates (Old Process)

STACK #	DATE	HYDROCARBON CONCENTRATION (as CH ₄)		HYDROCARBON (CH ₄) EMISSION RATE kg/hr
		mg/m ³	ppm	
1	Nov. 15, 1977	32.033	64.163	0.300
2	Nov. 16, 1977	97.309	194.910	0.869
3	Nov. 9, 1977	73.469	147.159	0.697
4	Nov. 8, 1977	126.560	253.500	0.514

Table 6:

Hydrocarbon Concentrations and Emission Rates (New Process)

STACK #	DATE	HYDROCARBON CONCENTRATION (as CH ₄)		HYDROCARBON (CH ₄) EMISSION RATE kg/hr
		mg/m ³	ppm	
1	July 6, 1979	54.074	108.31	0.530
2	July 5, 1979	73.530	147.28	0.644
3	July 6, 1979	57.574	115.32	0.549
4	July 5, 1979	40.964	82.05	0.138

Table 7:

Comparison of Hydrocarbon Concentrations

STACK #	HYDROCARBON CONCENTRATION (as CH ₄) (ppm)		PERCENTAGE CHANGE
	OLD PROCESS	NEW PROCESS	
1	64.16	108.31	+ 68.8
2	194.91	147.38	- 24.4
3	147.16	115.32	- 21.6
4	253.50	82.05	- 67.6
Average *	164.93	113.24	- 31.3 **

* Represents an arithmetic mean and not a weighted average.

** Represents change in the average.

Table 8:

Comparison of Hydrocarbon Emission Rates

STACK #	HYDROCARBON EMISSION RATES (as CH ₄) (kg/hr)		PERCENTAGE CHANGE
	OLD PROCESS	NEW PROCESS	
1	0.300	0.530	+ 76.7
2	0.869	0.644	- 25.9
3	0.697	0.549	- 21.2
4	0.514	0.138	- 73.2
Average	0.595	0.465	- 21.8 *

* Represents changes in the average.

Table 9:

Aldehyde Concentrations and Emission Rates (Old Process)

STACK #	DATE	ALDEHYDE CONCENTRATION (as HCHO)		ALDEHYDE (HCHO) EMISSION RATE kg/hr
		mg/m ³	ppm	
1	Nov. 16, 1977	7.925	6.24	0.074
2	Nov. 17, 1977	35.805	28.194	0.316
3	Nov. 17, 1977	27.565	21.706	0.260
4	Nov. 17, 1977	- *	- *	- *

* No analysis due to spoiled samples.

Table 10:

Aldehyde Concentrations and Emission Rates (New Process)

STACK #	DATE	ALDEHYDE CONCENTRATION (as HCHO)		Aldehyde (HCHO) Emission Rate kg/hr
		mg/m ³	ppm	
1	July 4, 1979	5.785	4.555	0.053
2	July 5, 1979	18.135	14.285	0.157
3	July 5, 1979	11.154	8.785	0.102
4	July 6, 1979	3.688	2.905	0.013

Table 11:

Comparison of Aldehyde Concentrations

STACK #	ALDEHYDE CONCENTRATION (as HCHO) (ppm)		PERCENTAGE CHANGE
	OLD PROCESS	NEW PROCESS	
1	6.240	4.555	- 27.0
2	28.194	14.285	- 49.3
3	21.706	8.785	0 59.5
4	- *	2.905	- 0
Average **	14.035 + **	7.633 **	- 47.5 - ***

* No analysis due to spoiled samples

+ Total of only 3 stacks

- Comparison between 4 stacks, new process and 3 stacks, old process

o No comparison between old and new processes

** Represents an arithmetic mean, not a weighted average

*** Represents change in the average

Table 12:

Comparison of Aldehyde Emission Rates

STACK #	ALDEHYDE EMISSION RATE (as HCHO) (kg/hr)		PERCENTAGE CHANGE
	OLD PROCESS	NEW PROCESS	
1	0.074	0.053	- 28.4
2	0.316	0.157	- 50.3
3	0.260	0.102	- 60.8
4	- *	0.013	- 0
Average	0.217 +	0.081	- 62.7 **

* No analysis due to spoiled samples

+ Total of only 3 stacks

- Comparison between 4 stacks, new process and 3 stacks, old process

o No comparison between old and new

** Represents change in the average

Table 13:

Organic Acid Concentrations and Emission Rates (Old Process)

STACK #	DATE	ACID CONCENTRATIONS (as CH ₃ COOH)		ORGANIC ACID (CH ₃ COOH) EMISSION RATE kg/hr
		mg/m ³	ppm	
1	Nov. 15, 1979	263.89	103.23	2.48
2	Nov. 17, 1977	296.37	115.94	2.66
3	Nov. 10, 1977	291.09	113.87	2.67
4	Nov. 17, 1977	130.85	51.19	0.54

Table 14:
Organic Acid Concentrations and Emission Rates (New Process)

STACK #	DATE	ACID CONCENTRATIONS (as CH ₃ COOH)		ORGANIC ACID (CH ₃ COOH) EMISSION RATE kg/hr
		mg/m ³	ppm	
1	July 6, 1979	208.89	81.71	2.03
2	July 4, 1979	209.35	81.90	1.84
3	July 5, 1979	199.75	78.15	1.98
4	July 4, 1979	143.45	56.12	0.47

Table 15:
Comparison of Organic Acid Concentrations

STACK #	ORGANIC ACID CONCENTRATIONS (as CH ₃ COOH) (ppm)		PERCENTAGE CHANGE
	OLD PROCESS	NEW PROCESS	
1	103.23	81.71	- 20.8
2	115.94	81.90	- 29.4
3	113.87	78.15	- 31.4
4	51.19	56.12	+ 9.6
Average	96.06 *	74.47 *	- 22.5 **

* Represents an arithmetic mean, not a weighted average

** Represents change in the average

Table 16:
Comparison of Organic Acid Emission Rates

STACK #	ORGANIC ACID EMISSION RATES (as CH ₃ COOH) (kg/hr)		PERCENTAGE CHANGE
	OLD PROCESS	NEW PROCESS	
1	2.48	2.03	- 18.1
2	2.66	1.84	- 30.8
3	2.67	1.98	- 25.8
4	0.54	0.47	- 13.0
Average	2.09	1.58	- 24.4 *

* Represents change in the average

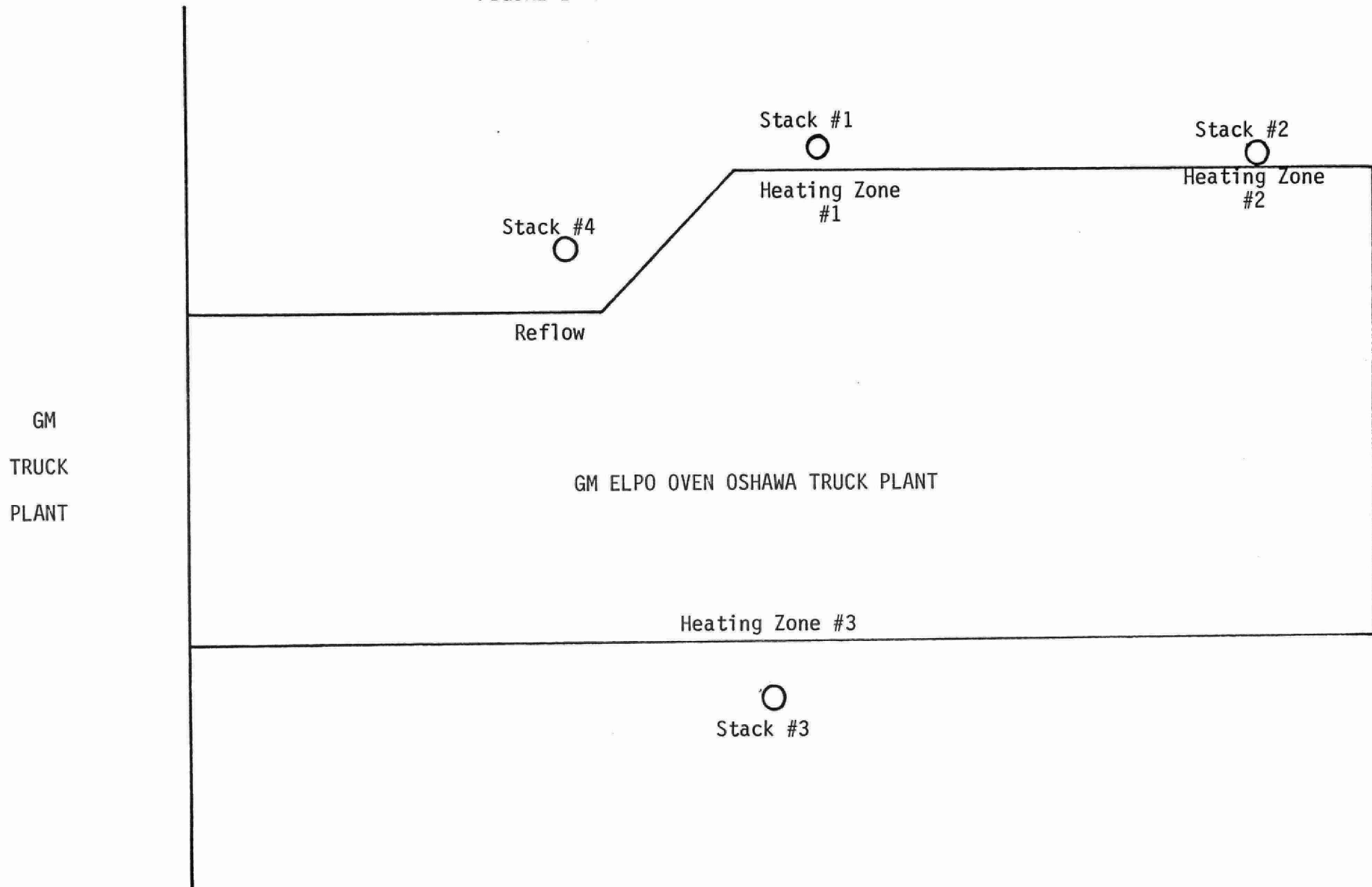
Table 17:

Particulate Concentrations and Emission Rates (Old Process)

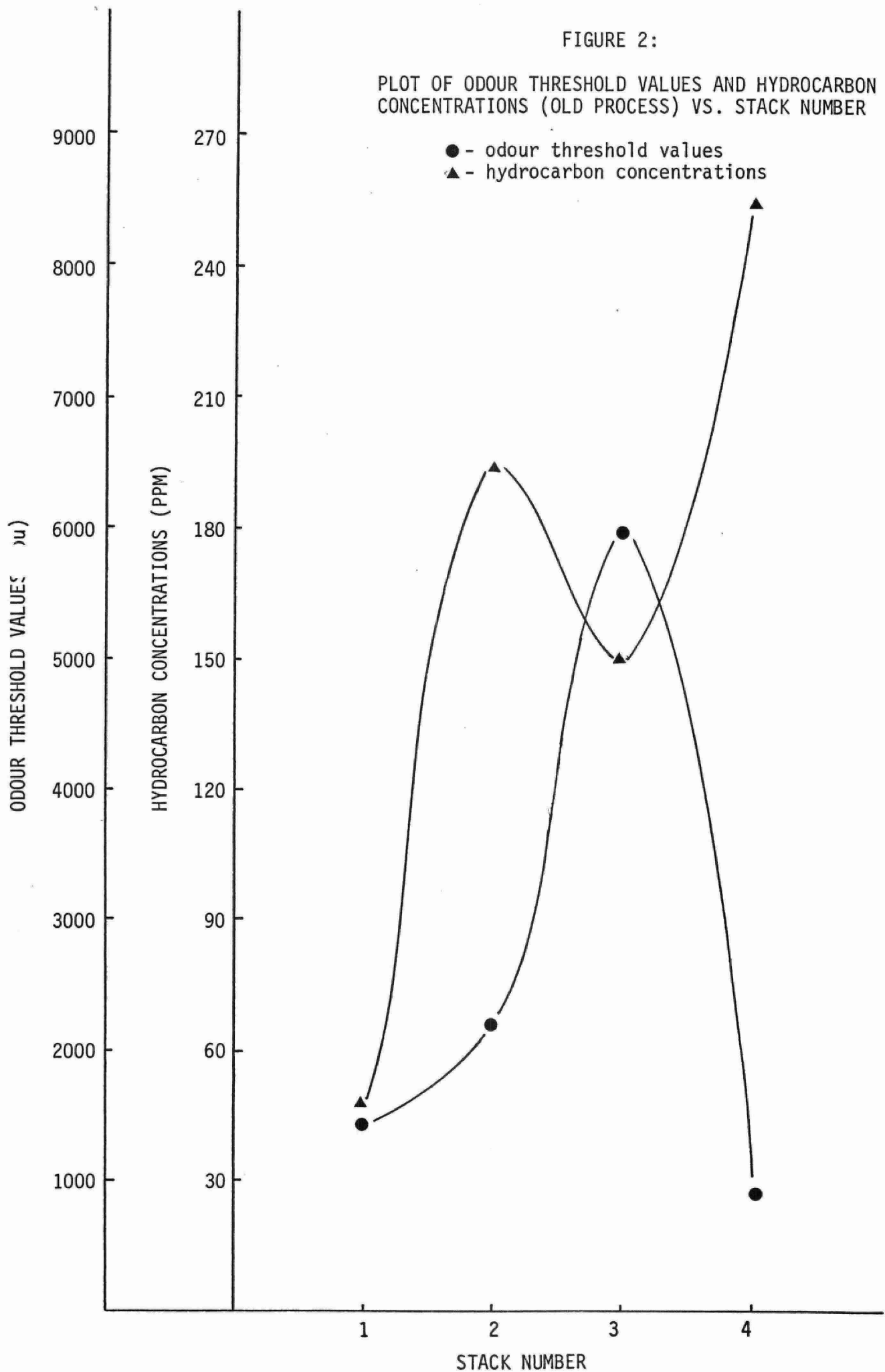
STACK #	DATE	PARTICULATE CONCENTRATION		PARTICULATE EMISSION RATE kg/hr
		mg/m ³	gr/SCF	
1	Nov. 15, 1977	1.830	7.998×10^{-4}	0.017
2	Nov. 17, 1977	4.83	2.111×10^{-3}	0.043
3	Nov. 10, 1977	3.021	1.320×10^{-3}	0.029
4	Nov. 17, 1977	2.562	1.120×10^{-3}	0.010
Average		3.061 *	1.338×10^{-3} *	0.025

* Represents an arithmetic mean and not a weighted average

FIGURE 1: ALLOCATION OF STACK NUMBER AND HEATING ZONES



*NOTE: Drawing not to scale.



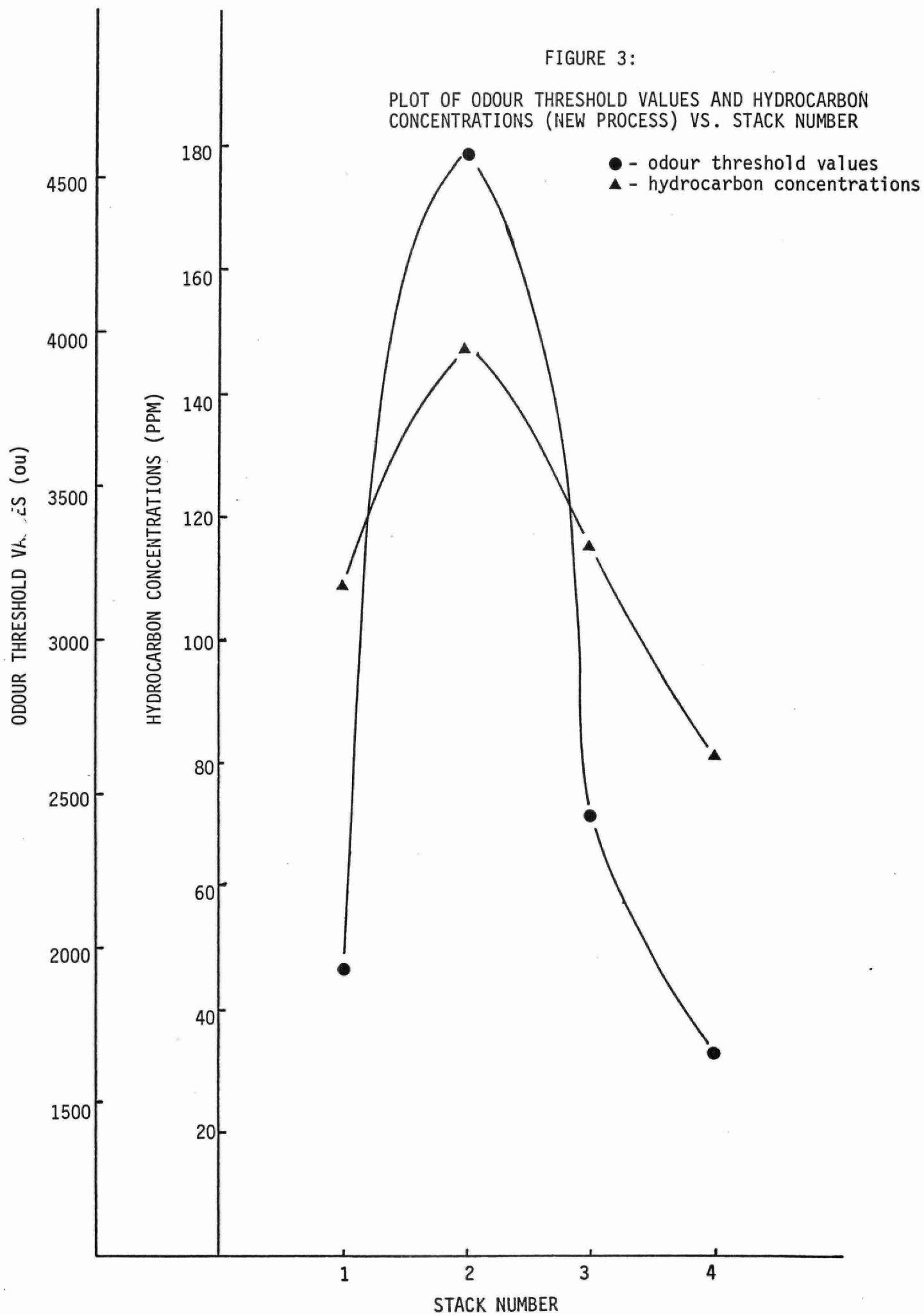


FIGURE 4:
PLOT OF ODOUR THRESHOLD VALUES AND ALDEHYDE
CONCENTRATIONS (OLD PROCESS) VS. STACK NUMBER

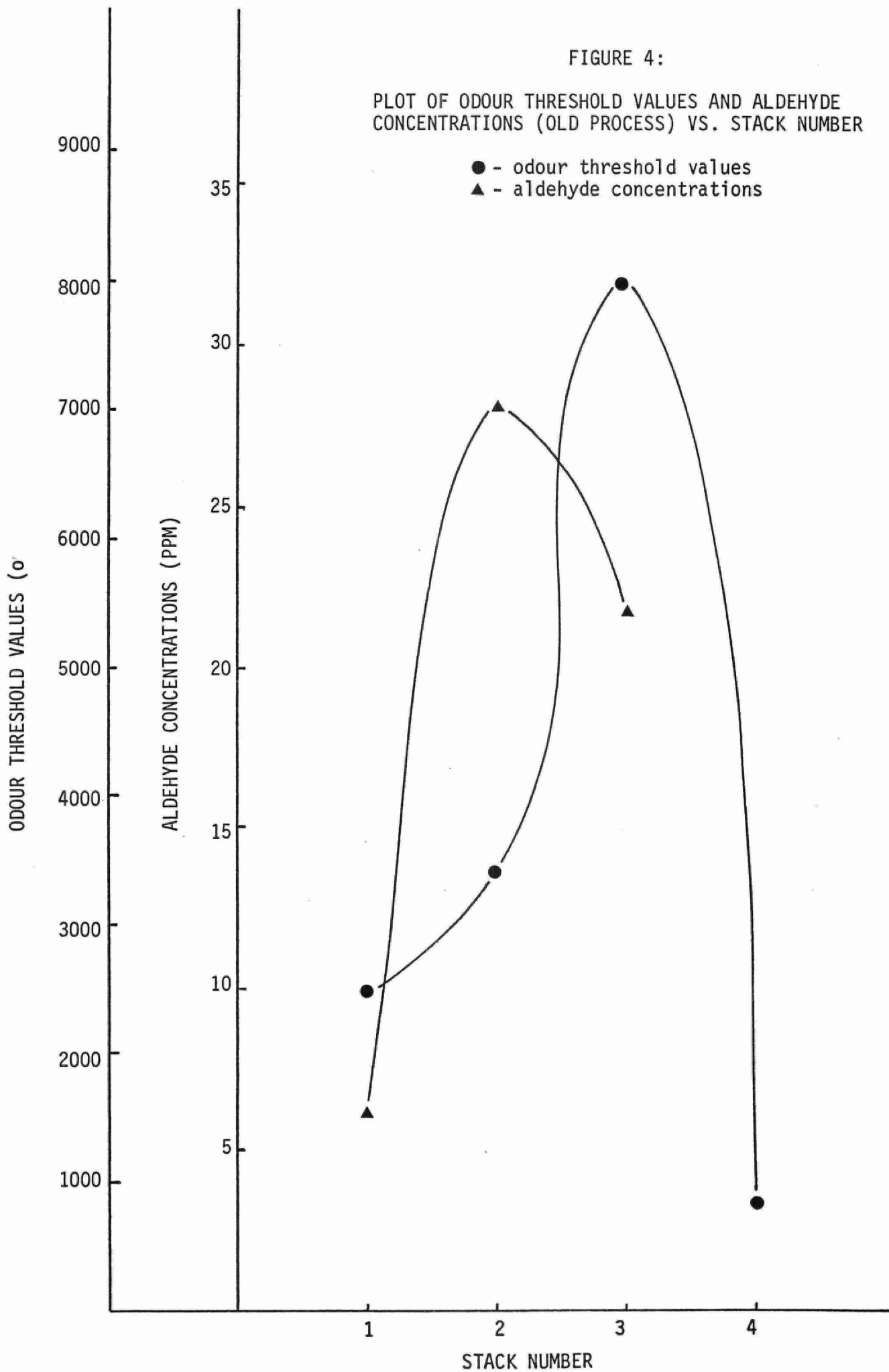


FIGURE 5:
PLOT OF ODOUR THRESHOLD VALUES AND ALDEHYDE
CONCENTRATIONS (NEW PROCESS) VS. STACK NUMBER

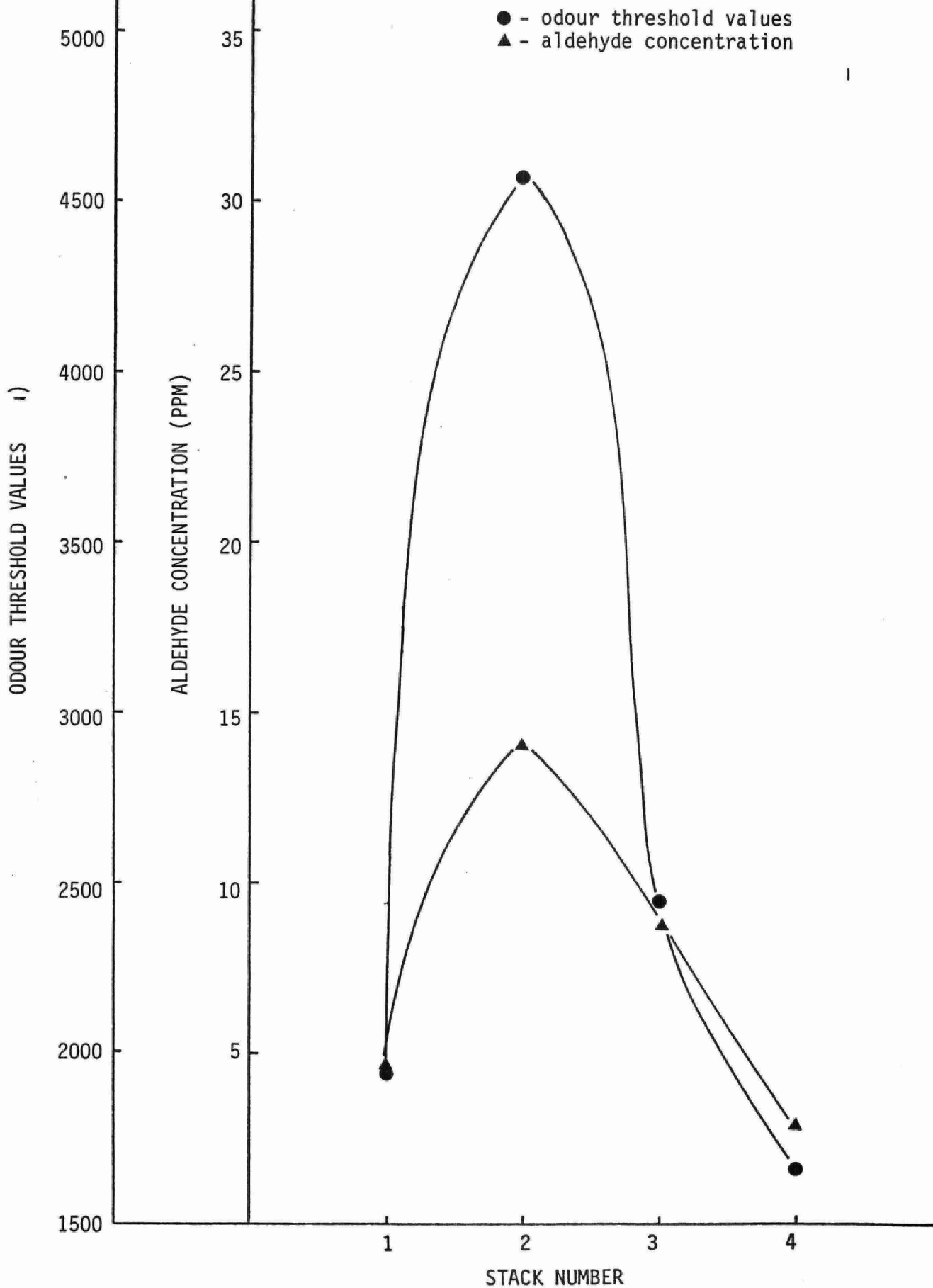
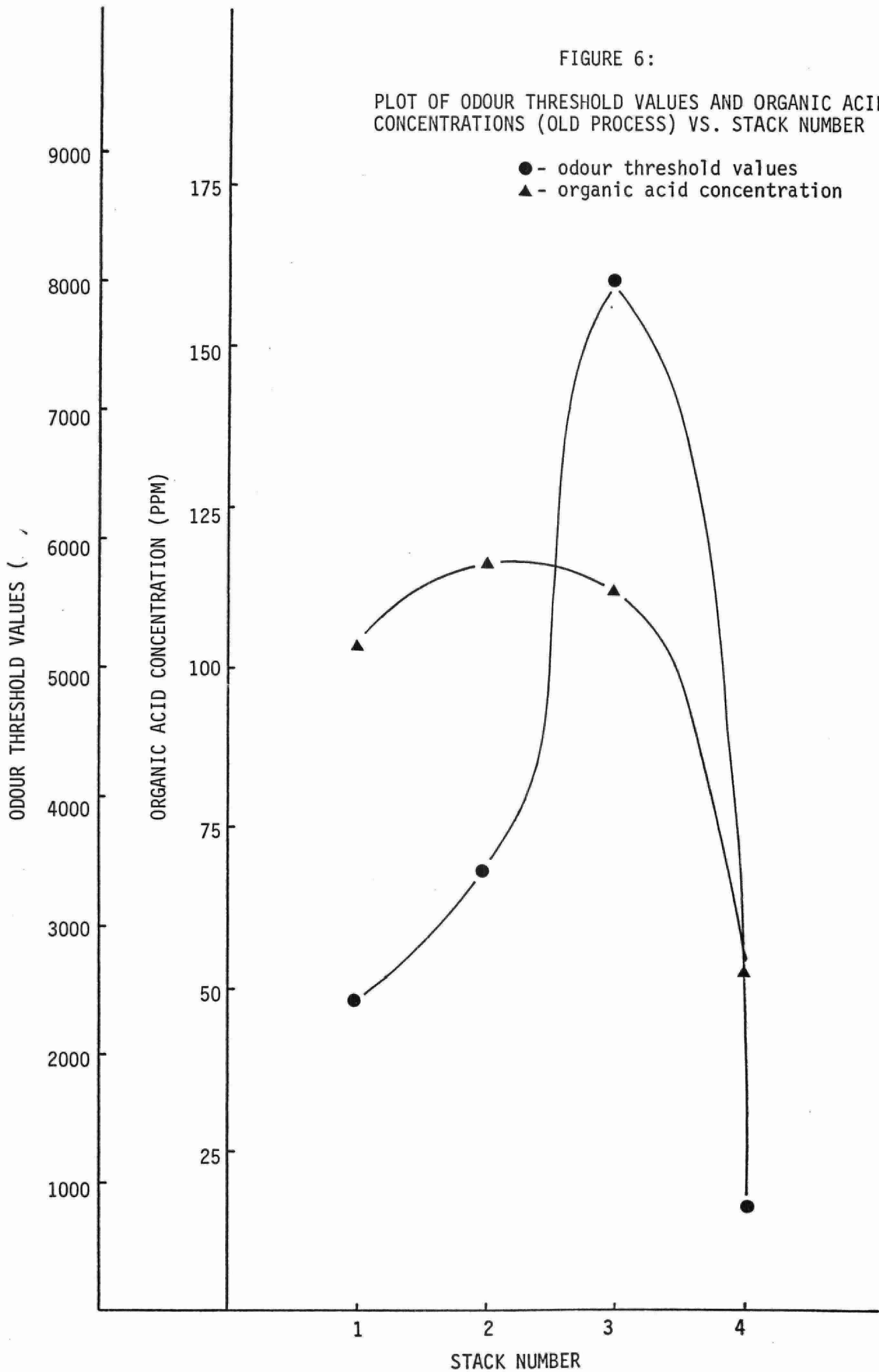
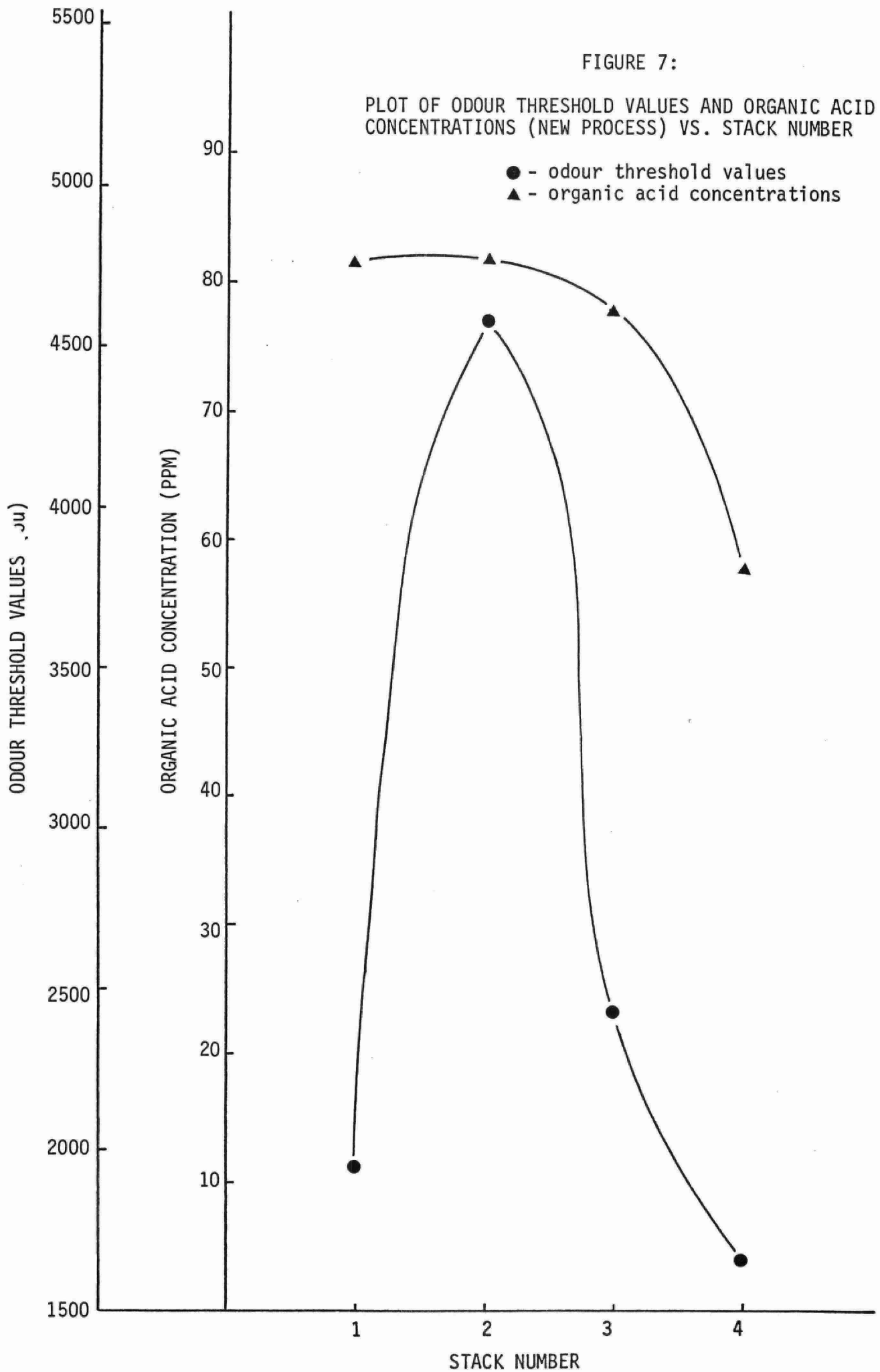


FIGURE 6:
PLOT OF ODOUR THRESHOLD VALUES AND ORGANIC ACID
CONCENTRATIONS (OLD PROCESS) VS. STACK NUMBER





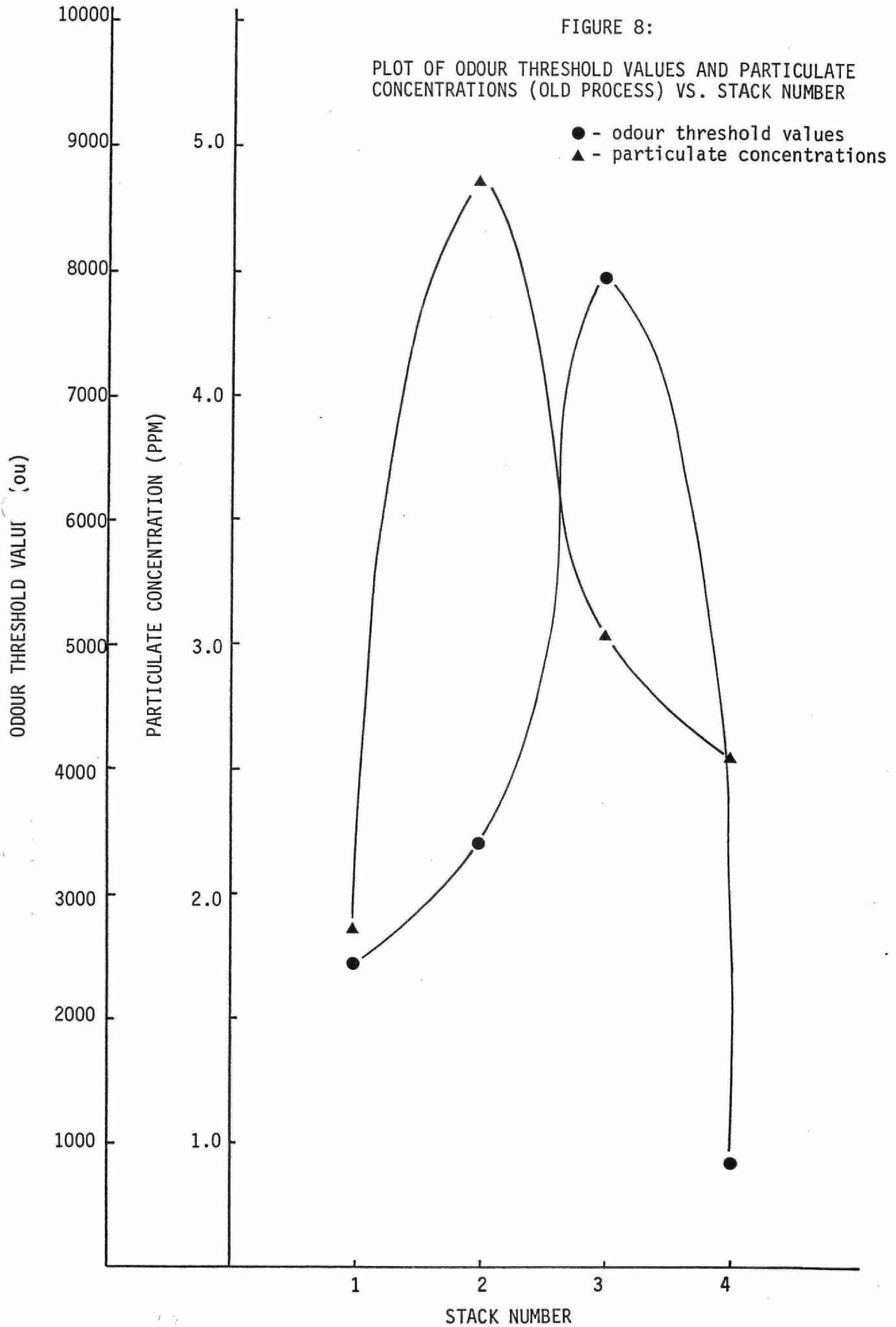
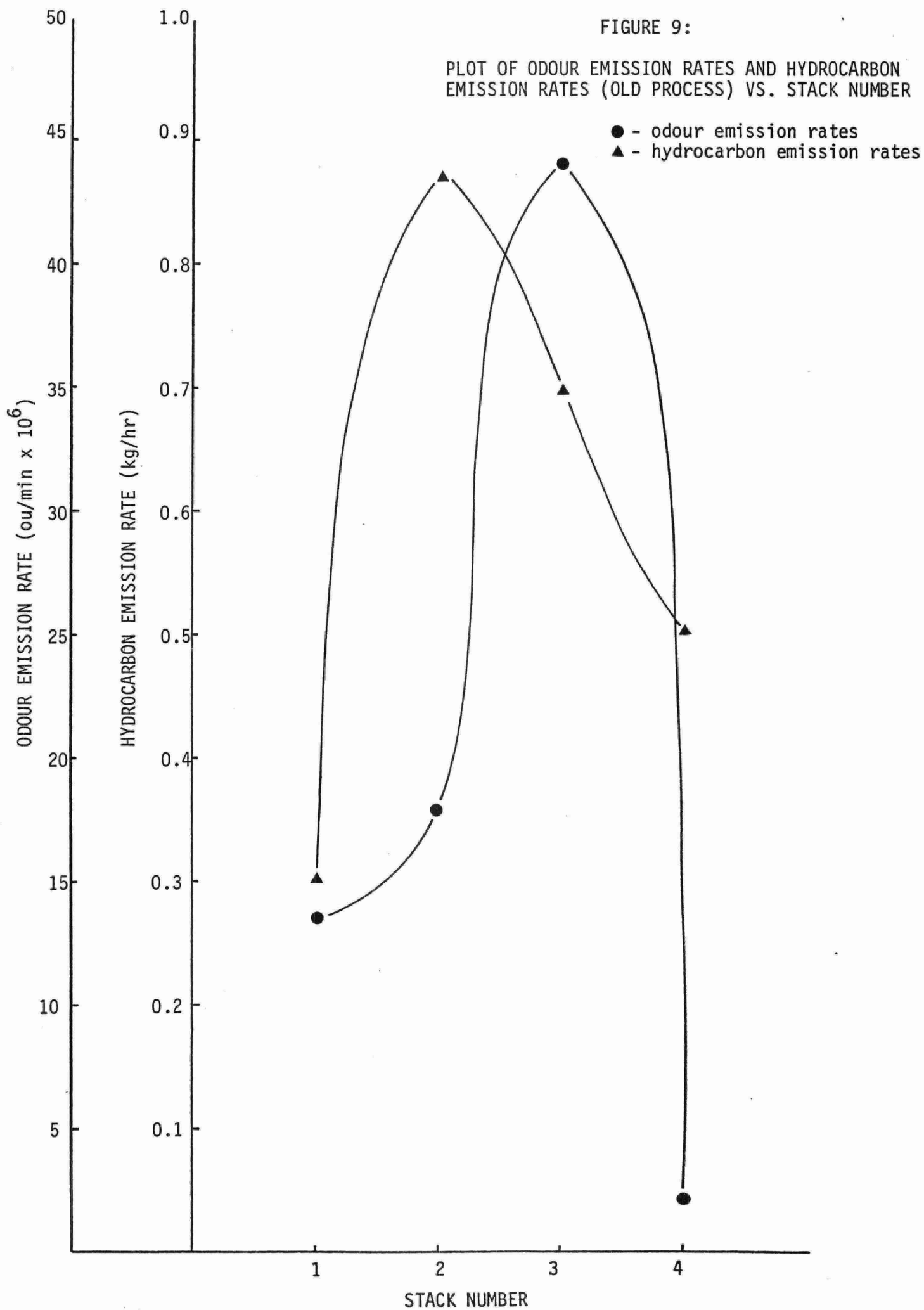


FIGURE 9:

PLOT OF ODOUR EMISSION RATES AND HYDROCARBON
EMISSION RATES (OLD PROCESS) VS. STACK NUMBER



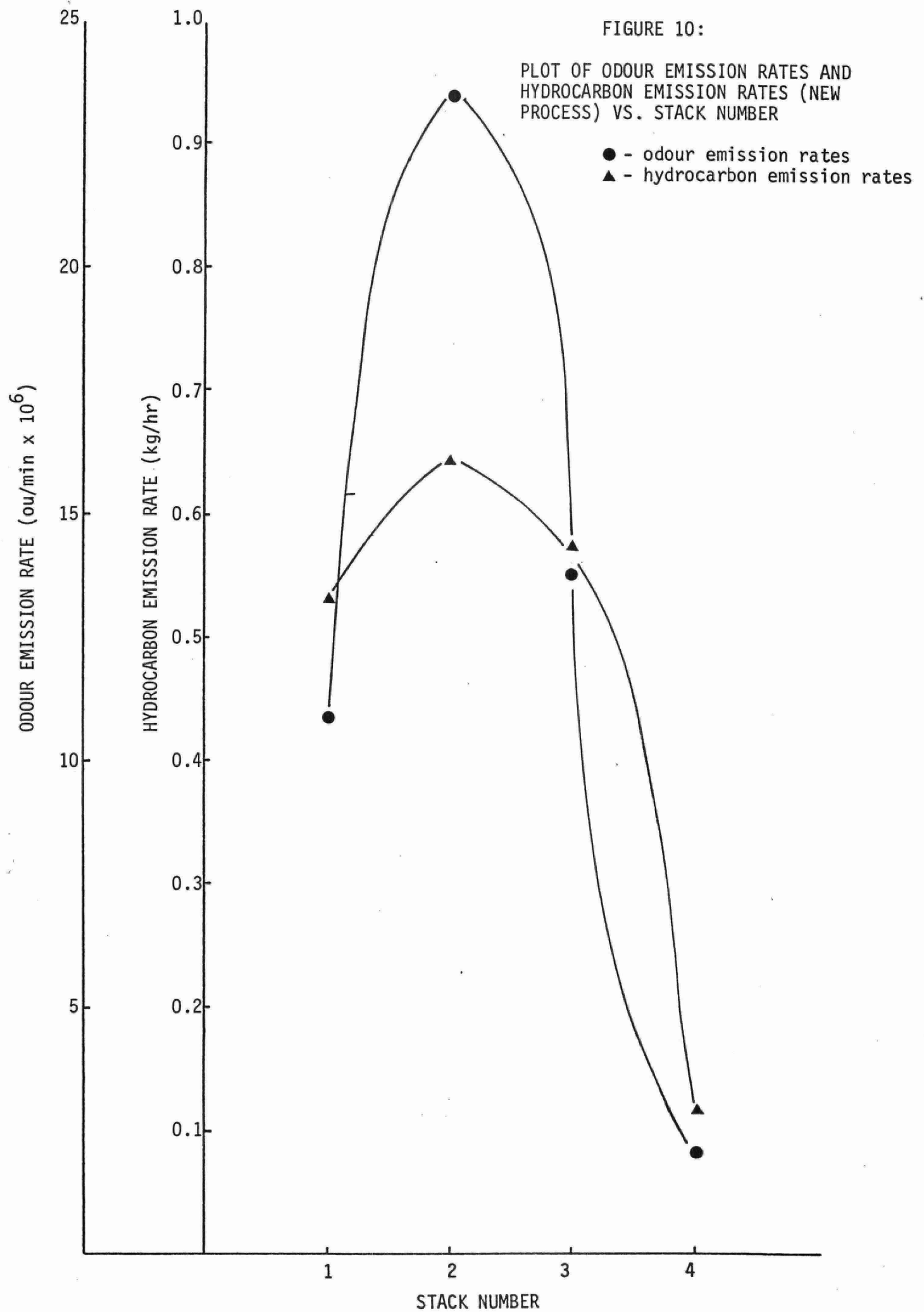


FIGURE 11:

PLOT OF ODOUR EMISSION RATES AND ALDEHYDE EMISSION RATES (OLD PROCESS) VS. STACK NUMBER

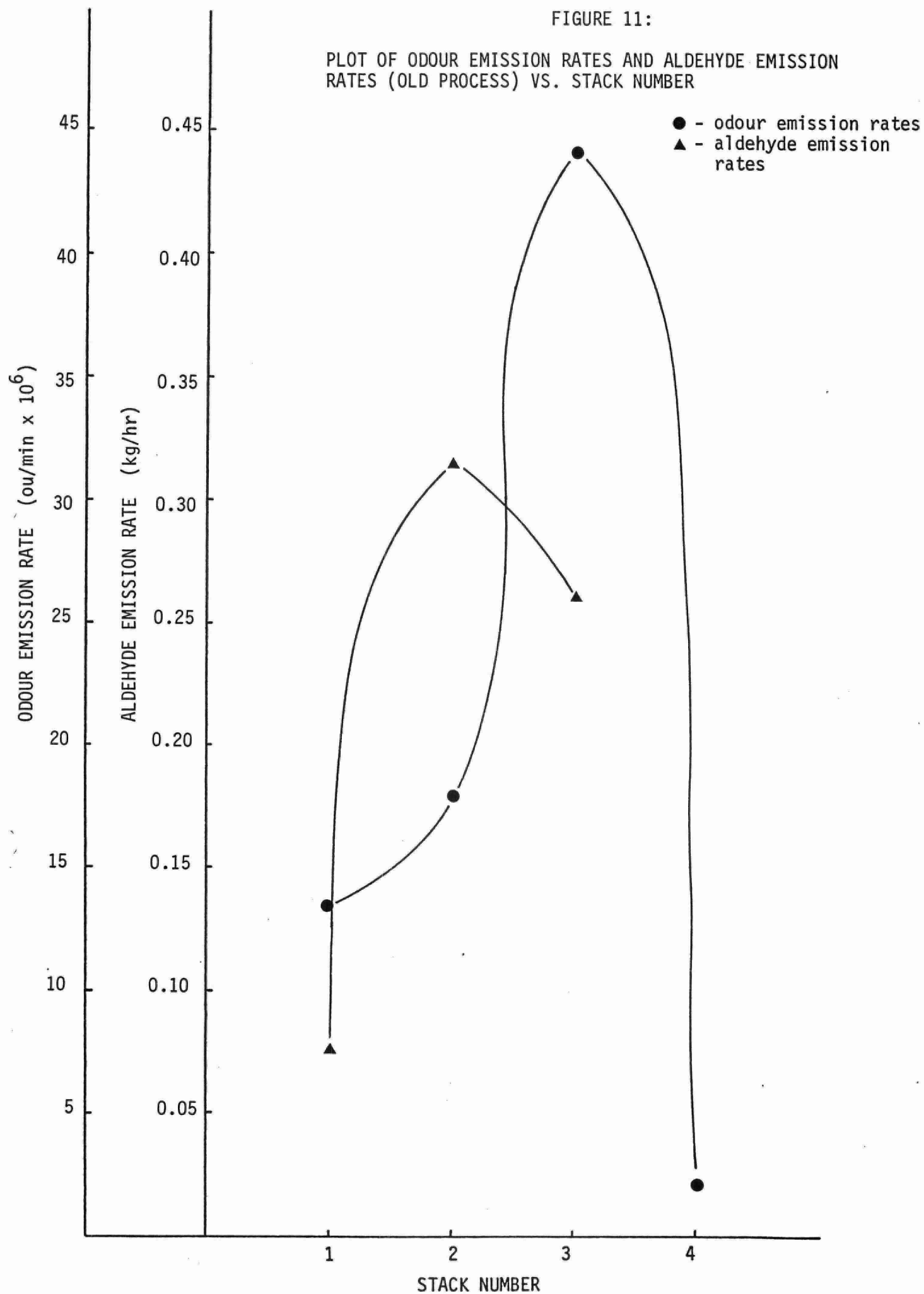


FIGURE 12:

PLOT OF ODOUR EMISSION RATES AND
ALDEHYDE EMISSION RATES (NEW PROCESS)
VS. STACK NUMBER

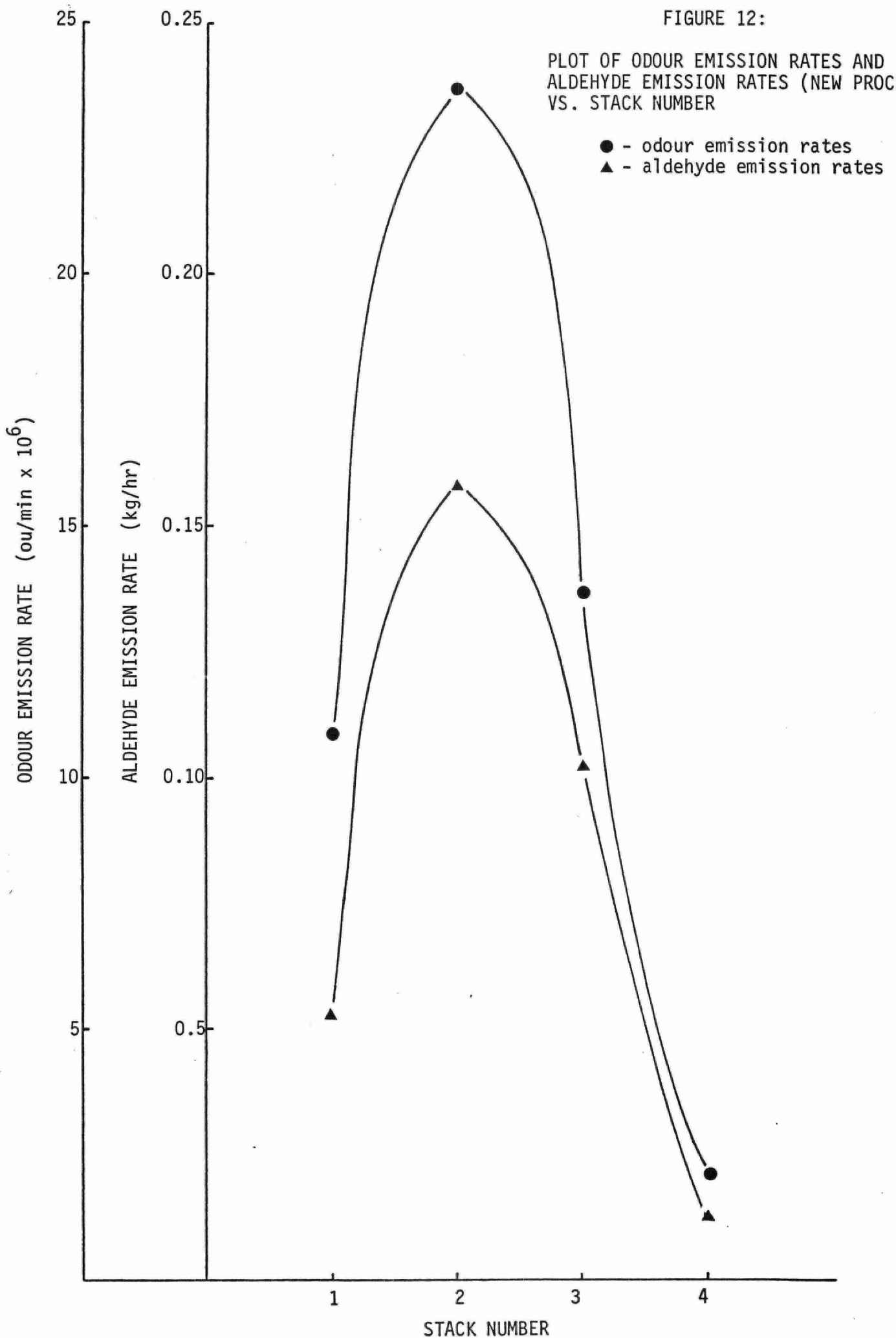


FIGURE 13:

PLOT OF ODOUR EMISSION RATES AND ORGANIC ACID
EMISSION RATES (OLD PROCESS) VS. STACK NUMBER

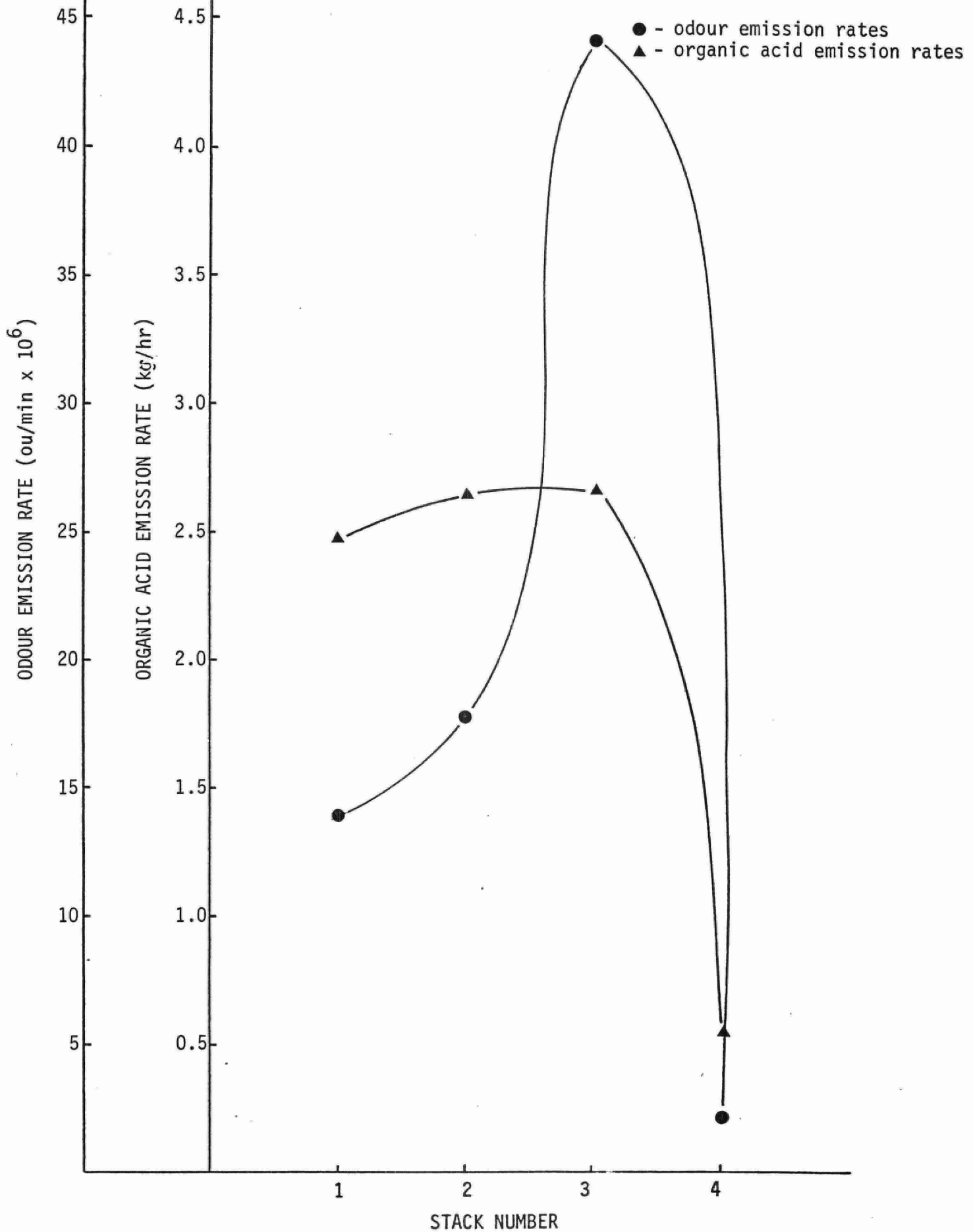


FIGURE 14:

PLOT OF ODOUR EMISSION RATES AND ORGANIC ACID EMISSION RATES (NEW PROCESS) VS. STACK NUMBER

● - odour emission rates
▲ - organic acid emission rates

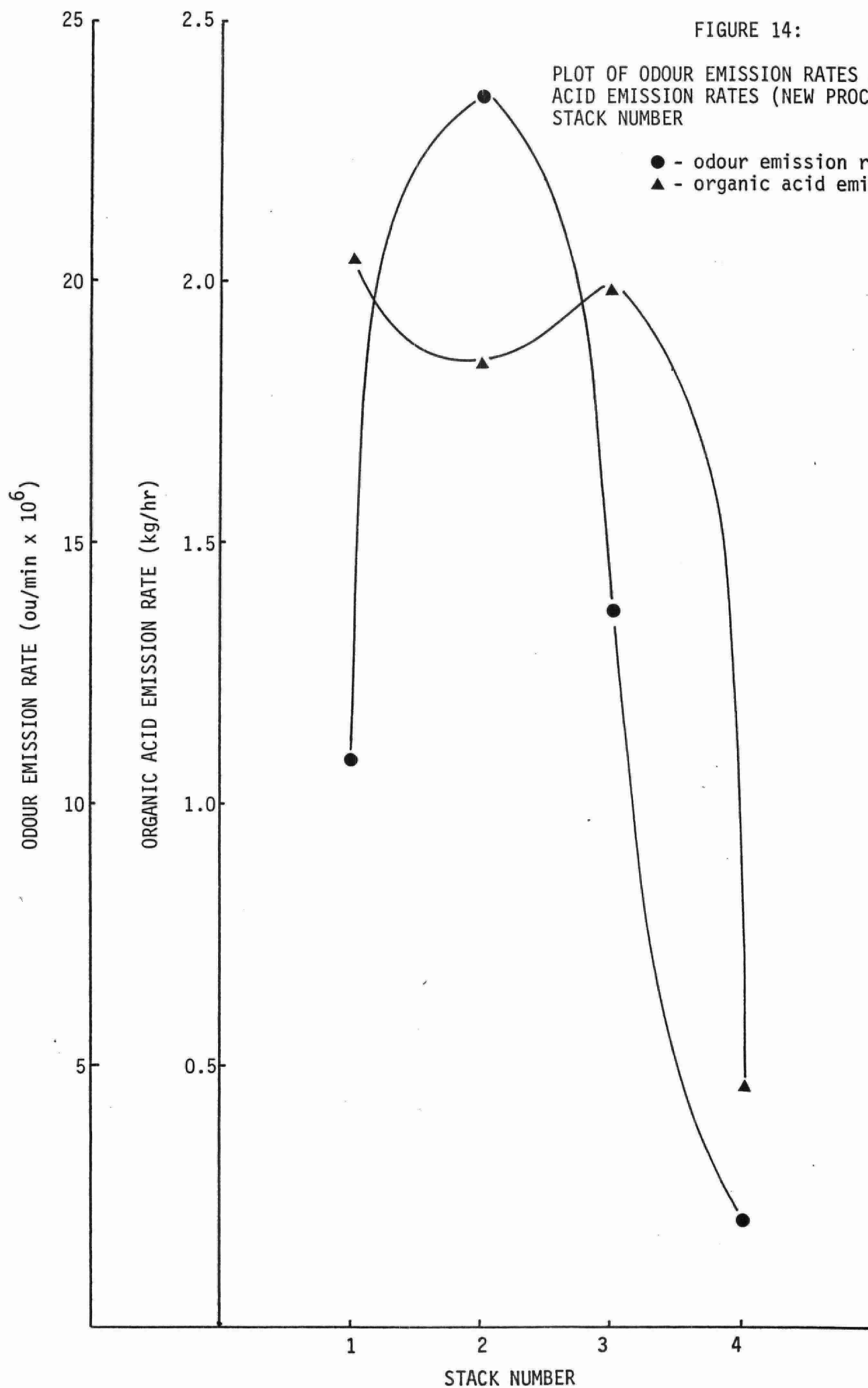
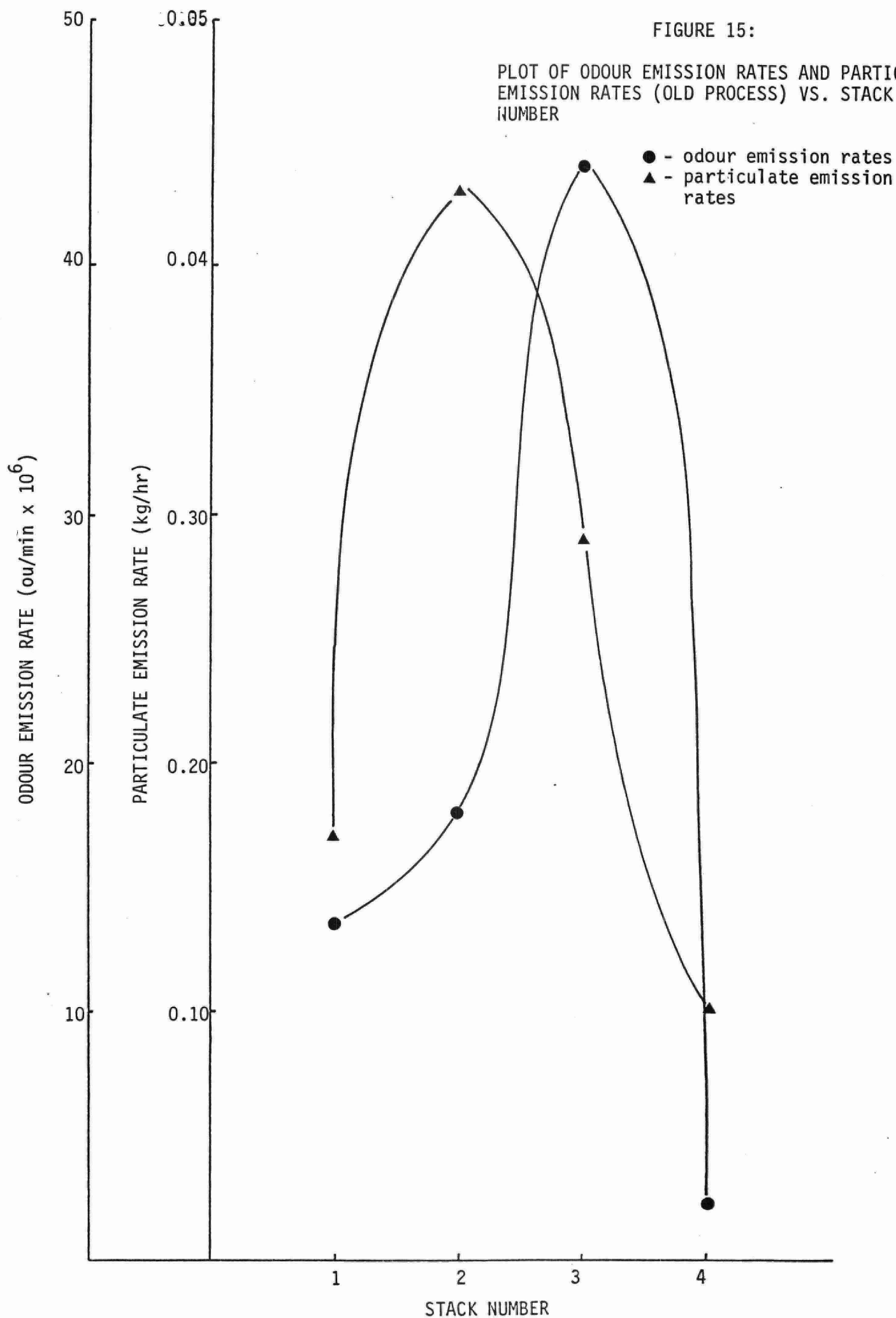


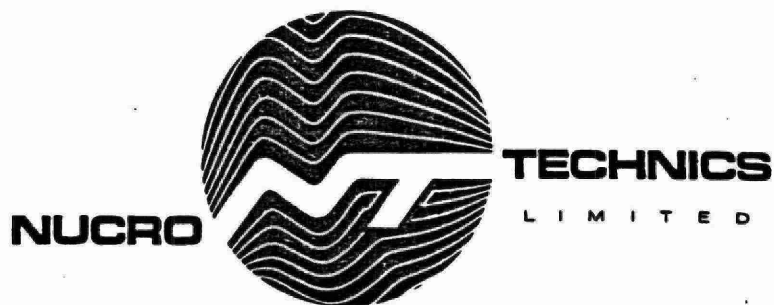
FIGURE 15:

PLOT OF ODOUR EMISSION RATES AND PARTICULATE
EMISSION RATES (OLD PROCESS) VS. STACK
NUMBER



APPENDIX A

FINAL REPORT OF THE ANALYSIS OF
IMPINGER SOLUTIONS FOR TOTAL ORGANIC ACIDS AND
TOTAL ALDEHYDES - NUCRO-TECHNICS



2000 ELLESMERE ROAD, UNIT 16, SCARBOROUGH, ONTARIO M1H 2W4 416/438-6727

FINAL REPORT ON THE ANALYSIS OF IMPINGER SOLUTIONS
FOR TOTAL ORGANIC ACIDS AND TOTAL ALDEHYDES

for

Mr. Valdo Ozvacic, P. Eng.
Source Assessment Engineer
Technology Development & Appraisal Section
Air Resources Branch
Ministry of the Environment
880 Bay St.
Toronto, Ontario
M5S 1Z8

M.C.E. P.O. #A51662
N.T. Project #11102

December 23, 1977

Fred Seymour
Project Leader

vd

Vern Shute, B.Sc.
Director Analytical
Chemistry Services



2000 ELLESMERE ROAD, UNIT 16, SCARBOROUGH, ONTARIO M1H 2W4 416/438-6727

ADDITIONAL INFORMATION ON THE ANALYSIS
OF IMPINGER SOLUTIONS FOR TOTAL ORGANIC
ACIDS AND TOTAL ALDEHYDES

for

Mr. Valdo Ozvacic, P.Eng.
Source Assessment Engineer
Technology Development & Appraisal Section
Air Resources Branch
Ministry of the Environment
880 Bay St.
Toronto, Ontario
M5S 1Z8

M.C.E. P.O. #A51662
N.T. Project #11102

January 9, 1978

A handwritten signature in cursive script, appearing to read 'Fred Seymour'.

Fred Seymour
Project Leader

A handwritten signature in cursive script, appearing to read 'Vern Shute'.

Vern Shute, B.Sc.
Director Analytical
Chemistry Services

INTRODUCTION

Nucro-Technics has previously reported (Oct. 31, 1977) method validation data and analytical results for organic acids and aldehydes from stack emissions of commercial kitchens. Method validation data for total organic acids and total aldehydes was presented at that time. Additional impinger solution samples were received on Nov. 25, 1977 originating from stack emissions from automotive paint drying ovens. The samples had not been refrigerated and were in screw cap clear glass bottles. Results of analyses of these samples are described along with additional method validation data.

I) ORGANIC ACID ANALYSIS

A) Further Validation for Total Organic Acids

A sample of glacial acetic acid (Assay Value 99.9% wt/vol.) 752.1 mg was dissolved in 5% NaOH and made to 1.00 litre in a class A volumetric flask. A 1/10th dilution was prepared in 5% NaOH. The results are summarized in Table 1. Recoveries for acetic acid ranged from 75% to 82%, closely agreeing with our previous average recovery of 76%.

ORGANIC ACID ANALYSIS

Additional information was requested:

- 1) The volume of sample taken for extraction and titration was 50 milliliters.
- 2) The normality and volume of the 0.1N NaOH solution consumed. The requested volumes and normality is arranged by tables as originally reported. The Tables have been expanded to include this additional information.

TOTAL ALDEHYDE ANALYSIS

The volume of sample taken for titration was 1.0 milliliters as reported in section (b) Results of Total Aldehyde Samples, page 5 Interim Report of October, 31, 1977. The exact normality of the 0.005N Iodine titrant was 0.00459N. The supplied blank required 0.075 milliliters of titrant.

The column headed Average Volume of 0.00459 Iodine Required (mls) of Table V, page 5, Interim Report of October 31, 1977, gives the volume of 0.00459N Iodine titrant consumed, without blank subtraction. The column headed Average Volume of 0.00518N Iodine Required (mls) of Table III, Final Report of December 23, 1977, gives the volume of 0.00518N Iodine titrant consumed without blank subtraction.

Correction in Table V, page 5, Total Aldehydes in 1% Sodium Bisulfite Impinger Solution, October 28, 1977. Line 1, I & PW from C & B 25/9/77 should read 70.6 milligrams Total Aldehydes in Sample.

TABLE 1

<u>SAMPLE</u>	<u>VOLUME 0.1N NaOH CONSUMED</u>	<u>NET VOLUME 0.1N NaOH CONSUMED</u>	<u>ACETIC ACID RECOVERED (mg/l)</u>	<u>% RECOVER</u>
Blank	0.40 ml	—	—	—
752 mg/l.	5.15 ml	4.75 ml	583.7	77.6%
752 mg/l	5.00 ml	4.60 ml	565.3	75.2%
75.2 mg/l.	0.90 ml	0.50 ml	61.4	81.7
75.2 mg/l.	0.90	0.50 ml	61.4	81.7

B) Results for Total Organic Acids

Results of total organic acid analyses in the four G.M. samples are presented in Table II.

C) Discussion of the Results Obtained for Total Organic Acids

Considerable variation was found between repeat analyses conducted on 25/11/77 and 28/11/77 using identical technique by the same analyst. Since the results of the 28th were lower than those of the 25th, the possibility of variation between batches of ether was suggested. As well, the odour of these samples was more pronounced than that of the previous samples suggesting a higher degree of volatility. Accordingly, the procedure was carried out using acid-washed ether to reduce the variation between batches of ether. The ether after washing with dilute HCl in a separatory funnel was dried by filtering thru anhydrous Na₂SO₄. As well, a comparative test to measure the affect of using prechilled ether and acidifying the sample when covered with a layer of prechilled ether was carried out. The rest of the extraction was carried out using prechilled ether and an ice-bath to reduce the necessity for venting the separatory funnel during the extraction.

A single sample -001 was analyzed in duplicate using acid washed ether with and without a cold technique to evaluate losses due to the more volatile nature of these samples.

In both cases the organic acid (mg/l) rose dramatically. The increase in the cold technique over room temperature handling was 25% indicating a surprising degree of loss from the sample during room temperature handling. The close agreement of the duplicates should be noted.

Accordingly, the four G.M. samples were reanalyzed using acid-washed prechilled ether and a cold technique. The results (mg/l) again rose dramatically from the results of 25/11/77 and 28/11/77. However the lack of agreement with the single result of 2/12/77 was noted without explanation.

TABLE II A

TOTAL ORGANIC ACIDS IN 5% NaOH IMPIN X SOLUTION
(28/11/77)

Sample #	Source	Location	Date	Age (Days)	Total Sample Volume (mls)	Concentration (mg/l)	Total in Sample (mg)
GM-03-0A-001	GM-ELPO	Stack # 03-ACK	10/11/77	18	660	573.2	378.3
GM-01-0A-003	GM-ELPO	Stack # 01-HF	15/11/77	13	511	585.2	299.0
GM-04-0A-008	GM-ELPO	Stack # 04-Reflow- WB	17/11/77	11	682	394.0	268.7
GM-02-0A-006	GM-ELPO	Stack # 02-GR	17/11/77	11	596	549.4	327.6

Addition to Table IIA of December 23, 1977

TOTAL ORGANIC ACIDS IN 5% NaOH IMPINGER SOLUTION
(28/11/77)

<u>SAMPLE #</u>	<u>VOLUME OF 0.1N NaOH</u> <u>CONSUMED (MLS)</u>	<u>VOLUME OF 0.1N NaOH</u> <u>CONSUMED LESS BLANK (MLS)</u>
GM-03-0A-001	5.50	4.8
GM-01-0A-003	5.60	4.9
GM-04-0A-008	4.0	3.3
GM-02-0A-006	5.30	4.6
Blank	0.70	--

NOTE: Exact normality of 0.1N NaOH was 0.09552N

Revised 9/1/78

TABLE II B

TOTAL ORGANIC ACIDS IN 5% NaOH IMPINGER SOLUTION

Sample # Note: Source, Location and Date as per Table II A.	Age (Days)	Total Sample Volume (mls)	Concentration (mg/l)	Total in Sample (mg)
<u>Date Tested - 25/11/77</u>				
GM-03-0A-001	15	660	286.8	189.3
GM-01-0A-003	10	511	268.9	137.4
GM-04-0A-008	8	682	274.9	187.5
GM-02-0A-006	8	596	298.8	178.1
<u>Date Tested - 2/12/77</u>				
GM-03-0A-001	22	660	a) 785.2	518.2
GM-03-0A-001	22	660	767.2	506.4
GM-03-0A-001	22	660	b) 985.2	650.2
GM-03-0A-001	22	660	1003.2	662.1
<u>Date Tested - 6/12/77</u>				
GM-03-0A-001	26	660	674.6	445.2
GM-01-0A-003	21	511	716.4	366.1
GM-04-0A-008	19	682	453.8	309.5
GM-02-0A-006	19	596	644.8	384.3
* Analysis of 2/12/77 b) and 6/12/77 were done using prechilled acid washed diethyl ether and ice bath throughout the technique.				

Addition to Table IIB of December 23, 1977

TOTAL ORGANIC ACIDS IN 5% NaOH IMPINGER SOLUTION

<u>SAMPLE #</u>	<u>VOLUME OF 0.1N NaOH CONSUMED (MLS)</u>	<u>VOLUME OF 0.1N NaOH CONSUMED LESS BLANK (MLS)</u>
Date Tested 25/11/77		
GM-03-0A-001	2.75	2.40
GM-01-0A-003	2.60	2.25
GM-04-0A-008	2.65	2.30
GM-02-0A-006	2.85	2.50
Blank	0.35	--

Exact normality of 0.1N NaOH was 0.09959N

Date Tested 2/12/77		
GM-03-0A-001	7.175	6.575
GM-03-0A-001	7.025	6.425
GM-03-0A-001	8.85	8.25
GM-03-0A-001	9.0	8.40
Blank	0.6	--

Exact normality of 0.1N NaOH was 0.09952N

Date Tested 6/12/77		
GM-03-0A-001	6.00	5.65
GM-01-0A-003	6.35	6.00
GM-04-0A-008	4.15	3.80
GM-02-0A-006	5.75	5.40
Blank	0.35	--

Exact normality of 0.1N NaOH was 0.09951N

II) TOTAL ALDEHYDE ANALYSIS

A) The results for total aldehyde analysis of the five G.M. samples are shown in Table III. All samples were analyzed on 28/11/77.

B) Discussion

Two of the samples GM-007 and -009 were yellowish in colour.

Both of these samples gave difficulty on analysis. When sample-009 was analyzed in duplicate, one of the duplicates took on a permanent dark blue colour. Upon repetition in triplicate with special attention being given to continuous blowing with N₂ gas in order to blow off SO₂ dissolved in the sample, the triplicates were satisfactory and agreeable. Sample - 007 was analyzed 5 times and on each occasion took on a permanent dark blue colour despite continuous blowing with N₂ gas. The excessive production of SO₂ gas was assumed to originate from break down of the 1% sodium bisulfite impinger solution either because of improper storage of the sample, or unknown stack effluents trapped in the sample reacting with the sodium bisulfite.

[In addition all five G.M. samples for aldehydes showed when viewed from above a refraction pattern (oil slick) indicative of a high level of organic material.]

III) RECOMMENDATIONS:

A) Organic Acids

It is obvious that there is considerable variation in the analytical results obtained for organic acid samples. It is our opinion that the variation is due to a variety of problems both with the sample and the method. It should be borne in mind that whenever duplicate analyses have been carried out within one day, either on samples or acetic acid recovery standards, there has been close agreement between the duplicates.

TABLE III

TOTAL ALDEHYDES IN 1% SODIUM BISULFITE
IMPINGER SOLUTION NOV. 28/77

Sample Designation	Sampling Date	Appearance	Total Sample Volume (mls)	Average volume of 0.00518 N Iodine required (mls)	Total Aldehydes in sample (mg)
GM-03-AP-002 GM-ELPO Stack #03 - ACK Aldehyde #1	Nov. 15/77	Clear and colourless	595	0.375 (2) 0.31	14.3 ^{14.0}
GM-01-AD-004 GM-ELPO Stack #01-WF Aldehyde #2	Nov. 16/77	Clear and colourless	545	0.265 (2) 0.260	8.47 ^{15.5}
GM-02-AD-005 GM-ELPO Stack #02-GR Aldehyde	Nov. 17/77	Clear and colourless	625	0.835 (2) 0.77	37.4 ^{59.8}
GM-04-AD-007 GM-ELPO Stack #04-Reflow WB	Nov. 17/77	Clear and yellowish tint.	450	-	-
GM-03-AD-009 GM-ELPO Stack #03-ACK Aldehyde #2	Nov. 17/77	Cloudy and yellowish tint	720	0.610 (4)	30.5 ^{42.1}
Blank, None Supplied.	Nov. 28/77		-	0.065 0.505	-

recommendations were not received until after the completion of the programme.

A) Cont'd

The samples were not refrigerated immediately after collection as previously recommended. The suggestions made in the previous report were made to reduce sample degradation and to provide undegraded samples so that the time course of sample degradation could be followed. Aldehydes present in the same stack effluent could be trapped in the 5% NaOH impinger solution and oxidized to the corresponding carboxylic acids. This reaction takes place under chemically mild room temperature conditions¹. Loss of volatile sample could occur both in the sample bottle into the head space and, thence to the room atmosphere by leakage or when the bottle is opened and when the sample is being analyzed on the bench.

Verification of linearity and recovery of the assay procedure has been limited to acetic acid. The wide variety of organic acids possible suggests that the methodology be proven for the major suspected organic acids whether it be long chain fatty acids from cooking hamburgers or aromatic acids from the drying of automotive paints. The stability of these major components should be evaluated by spiking into 5% NaOH solution and actual samples.

Knowledge of the solvents used in the paints and of the temperature, moisture, and other conditions in the drying oven area would be helpful in theorizing the possible organic acid products. For example, alcohols readily oxidize to aldehydes in the presence of oxygen and water under high temperature conditions². Continued oxidation to carboxylic acids may occur.

B) Aldehydes

Given the above example, knowledge of the alcohol content of the paints and solvents used would be a strong indication that the corresponding aldehyde would appear in the stack effluent.

B) Cont'd

This as well suggests a potential method of analysis being the catalytic hydrogenation of the aldehydes back to the corresponding alcohols. The alcohol mixture could then be chromatographed using G.L.C. with high polarity carbowax and/or porous polymer columns. Identification by relative retention time and accurate quantization should be possible. Such finger printing would be further proof as to identifying the source of odour production.

REFERENCES

1. Organic Chemistry 2nd ed., Eds. Morrison and Boyd, Allyn Bacon, Inc., page 644, section 19.18 Cannizzaro Reaction.
2. Ibid, page 636, section 19.11

APPENDIX B

ODOUR EVALUATION AND PARTICULATE EMISSION DETERMINATION

Odour Evaluation:

The Ontario Research Foundation (ORF) dynamic dilution olfactometer contains 6 chambers or cubicles and each cubicle contained 2 sniff ports. The odour sample is passed through one set of 6 of these ports while odourless air is passed through the other. The panelist sniffs both ports in his/her cubicle and if certain of the detection of odour, activates a switch which lights a light at the unit control panel, where the operator notes the panelist's response. This procedure is repeated over a range of dilutions from the one that none of the panelists could detect to the one that all panelists could detect.

The ORF olfactometer is different from the IITRI dynamic triangle olfactometer in the following ways:

1. The IITRI olfactometer uses 3 sniff ports while the ORF olfactometer uses only 2 sniff ports.
2. The ORF olfactometer is capable of varying its dilution ratios from 5:1 to 100,000:1, while the IITRI olfactometer has 6 fixed dilution ratios.
3. The IITRI evaluation procedure is a 'force choice' method, while the ORF evaluation procedure is not.
4. The IITRI olfactometer evaluates each panelist individually; the ORF olfactometer evaluates all 6 panelists simultaneously.
5. The ORF olfactometer is limited to employing 6 panelists for evaluation of an odour sample; the IITRI olfactometer can use an unlimited number of panelists to evaluate an odour sample.

ORF employs a graphical technique in determination of the odour threshold values (OTVs); although the graphical OTV determination procedure is a valid tool in determining OTVs, it is

highly dependent on the analyst's placement of the curve. The error in curve fitting could affect the OTVs by $\pm 20\%$. SAU redetermined the OTVs using the Linear Regression analytical technique. The SAU OTVs can be found on Table B-1. The SAU OTVs were found to be slightly higher than the ORF OTVs.

TABLE B-1 ODOUR THRESHOLD VALUES

SAMPLE #	STACK #	PREDILUTION RATIO	OTV* (o.u.**)
1	1	None	365
2	1	None	212
3	1	4.7:1	2304
4	1	4.7:1	1573
1	'Gary'	None	638
2	'Gary'	None	657
3	2	4.7:1	4468
4	2	4.7:1	4679
1	3	None	436
2	3	None	383
3	3	4.7:1	1428
4	3	4.7:1	3527
1	4	None	698
2	4	None	510
3	4	3.3:1	1557
4	4	3.3:1	1767

* includes predilution factor

** ou ≡ one volume unit of the odourous gas diluted with x volume units of odourless air to reach the panel odour threshold value at which 50% of the panelists would not detect an odour. By convention, volume units are measured in cubic feet of gases.

ONTARIO RESEARCH FOUNDATION

SHERIDAN PARK RESEARCH COMMUNITY

MISSISSAUGA, ONTARIO, CANADA L5K 1B3 • (416) 822-4111 • TELEX 06-982311

September 25, 1979.

Mr. Gary Wong,
TDA Section,
Air Resources Branch,
Ministry of the Environment,
880 Bay Street, 4th Floor,
Toronto, Ontario.
M5S 1Z8

Dear Gary:

Enclosed are the copies of the data sheets for the odour testing done for our report APS-79-23.

As to your questions concerning the differences between the IITRI dynamic triangle olfactometer, and the dilution system used in our lab, they may be summarized as follows:

1. IITRI tests each member separately, we test all panel members at the same time.
2. IITRI uses 3 ports, we use 2.
3. IITRI method is a "forced choice", our method is not.
4. IITRI has six fixed dilutions, our method may use any number of dilutions, and any dilution from 5X to 100,000X.

In our system, there is one panelist in each of six cubicles. Each cubicle has two "sniff ports", with a push-button below each port that will switch on a light on the operator's control panel. The operator starts a highly diluted odour sample through either the left-hand or right-hand ports, and the panelists must decide which port carries the odorous air. If the panelist is sure that the odour is coming out of one of the ports, he pushes the button beneath that port. The operator records the responses of all the panelists at that dilution, then changes the dilution, and may switch the odorous air to the opposite port. This process continues until dilutions have been made from one that none of the panelists could detect to one that all the panelists could detect.

continued

Possibility
of port
contaminated

Dr. Gary Wong

(2) September 25, 1979.

Inconsistencies in the responses are resolved (for example one panelist detecting the odour at 1000X but not at 800X) and the responses (% of panelists) are plotted versus dilution on log-probit graph paper.

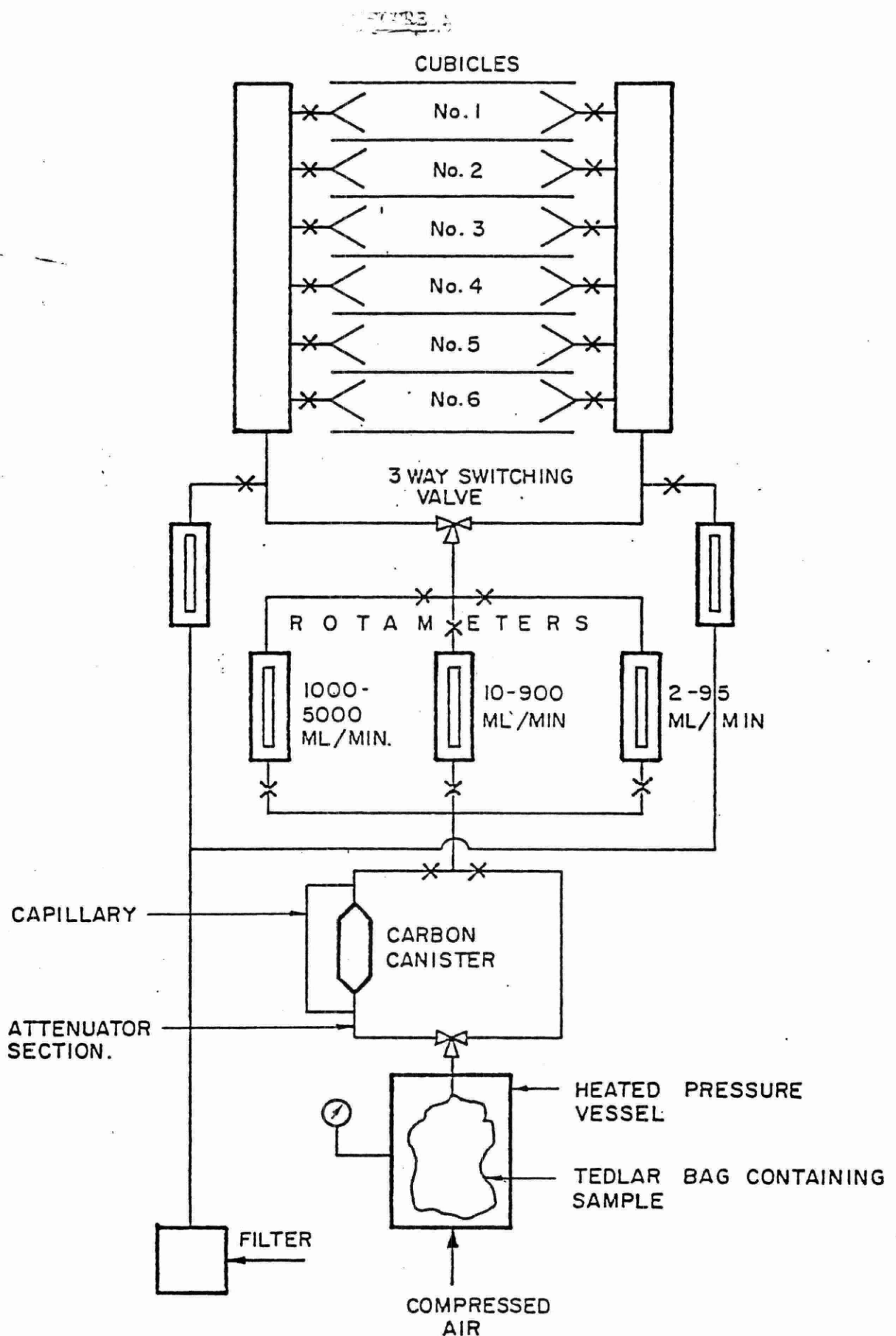
I hope that this explanation is adequate for your purposes. If it is not, please do not hesitate to call again.

Yours truly,



for Michael Rix
Assistant Research Scientist
Dept. of Environmental Chemistry

MR/sw
Encls.



O.R.F. DYNAMIC FLOW SYSTEM FOR EVALUATION OF ODOURS.

ONTARIO RESEARCH FOUNDATION

Department of Environmental Chemistry

ODOUR TEST PANEL

Sample #1 Source #1

Date July 5

sampled July 4 8:56 - 9:02 AM
no dilution.

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
#1	1000 X	A						✓	623.35
		B						✓	17
#2	800 X	A						✓	623.35
		B						✓	17
#3	600 X	A						✓	623.35
		B						✓	17
#4	500 X	A							
		B							
#5	400 X	A						✓	623.35
		B						✓	17
#6	300 X	A				✓	✓	✓	365.10
		B				✓	✓	✓	50
#7	200 X	A				✓	✓	✓	365.10
		B		✓	✓	✓	✓	✓	50
#8	100 X	A		✓	✓	✓	✓	✓	97.85
		B	✓	✓	✓	✓	✓	✓	83
#9	50 X	A	✓	✓	✓	✓	✓	✓	-39.82
		B							100
#10	X	A							
		B							

$$ED_{50} = 365.10$$

$$ED_2 = 753.83$$

$$ED_{98} = -23.62$$

$$a_1 = 770.03$$

$$a_0 = -8.10$$

$$r^2 = 0.66$$

$$Sy.x = 198.35$$

$$S_0 = 110.94$$

$$S_1 = 2.18$$

ONTARIO RESEARCH FOUNDATION

Department of Environmental Chemistry

ODOUR TEST PANEL

Sample # 2 Source # 1

Date July 5, 1979

sampled July 4 9:15
no dilution

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
# 1	515 X	(A)						✓	367.68
		B					✓		
# 2	300 X	(A)					✓	✓	292.03
		B							
# 3	200 X	A					✓	✓	
		(B)					✓	✓	292.03
# 4	100 X	A		✓			✓	✓	
		(B)		✓			✓	✓	211.66
# 5	75 X	A	✓	✓	✓		✓	✓	
		(B)	✓	✓	✓		✓	✓	55.65
# 6	50 X	A	✓	✓	✓		✓	✓	
		(B)	✓	✓	✓		✓	✓	55.65
# 7	25 X	A	✓	✓	✓	✓	✓	✓	
		(B)	✓	✓	✓	✓	✓	✓	-24.71
# 8	X	A							
		B							
# 9	X	A							
		B							
# 10	X	A							
		B							

$$E_{D50} = 211.66$$

$$E_{D.2} = 438.59$$

$$E_{D98} = -15.26$$

$$Q_0 = 448.04$$

$$Q_1 = -4.73$$

$$r^2 = 0.76$$

$$S_{y \cdot x} = 90.98$$

$$S_0 = 75.26$$

$$S_1 = 1.17$$

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ODOUR TEST PANEL

Sample # 3 Source # 1

Date July 5, 1979

sampled July 4 9:57-10:07 AM

dilution ratio 1:4.7

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
	5720	A						✓	17
# 1	1000 X	(B)				✓	✓	✓	4484.27
	2860	(A)				✓	✓	✓	2304.07
# 2	500 X	B							50
	Blank	A							0
# 3	Blank X	B				✓	✓		
	2288	(A)				✓	✓	✓	2304.07
# 4	400 X	B							50
	1716	A		✓			✓	✓	50
# 5	300 X	(B)		✓			✓	✓	2304.07
	1144	A		✓			✓	✓	
# 6	200 X	(B)		✓		✓	✓	✓	2304.07
	572	(A)		✓		✓	✓	✓	1180.93
# 7	100 X	B							67
	029	(A)		✓		✓	✓	✓	1180.93
# 8	15 X	B		✓					67
	286	(A)		✓	✓	✓	✓	✓	123.87
# 9	50 X	B				✓			83
	172	(A)	✓	✓	✓	✓	✓	✓	-999.27
#10	30 X	B							100

$$E_{D50} = 2304.07$$

$$E_{D2} = 5475.27$$

$$E_{D98} = -867.14$$

$$Q_0 = 5607.40$$

$$Q_1 = -66.07$$

$$r^2 = 0.77$$

$$S_{y.x} = 915.13$$

$$S_0 = 867.37$$

$$S_1 = 13.68$$

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ODOUR TEST PANEL

Sample #4 Source #1

Date July 5, 1979

sampled July 4 10:15 - 10:26 Am

dilution ratio 1:4.7

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
	5720	(A)						✓	3015.74
#1	1000X	B							17
		(A)							
#2	600X	B							0
	1144	A							
#3	900X	(B)					✓		3015.74
	572	A							17
#4	100X	(B)				✓	✓	✓	1572.92
	286	A							50
#5	50. X	(B)		✓	✓	✓	✓	✓	130.10
	172	A					✓	✓	83
#6	20 X	(B)		✓	✓		✓	✓	829.65
	57	A							67
#7	10 X	B	✓	✓	✓	✓	✓	✓	-613.17
		A							100
#8	X	B							
		A							
#9	X	B							
		A							
#10	X	B							

$$ED_{50} = 1572.92$$

$$ED_2 = 3671.57$$

$$ED_{98} = -525.72$$

$$a_0 = 3759.02$$

$$a_1 = -43.72$$

$$r^2 = 0.47$$

$$S_{y \cdot x} = 1783.55$$

$$S_0 = 1487.07$$

$$S_1 = 23.29$$

ONTARIO RESEARCH FOUNDATIONDepartment of Environmental ChemistryODOUR TEST PANEL

Sample #1 stack "Gary"
 Sampled July. 3 10:39-1041 AM
 no dilution.

Date July 8, 1979

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
		(A)							0 %
# 1	2000 X	B							
		(A)	✓	✓				795.28	33 %
# 2	1000 X	B							
		A						638.13	%
# 3	900 X	(B)	✓	✓	✓				50 ..
		A						638.13	%
# 4	800 X	(B)	✓	✓	✓				50
		(A)		✓				943.18	17 %
# 5	700 X	B							
		A		✓	✓			795.28	%
# 6	600 X	(B)		✓	✓				33
		A						480.98	%
# 7	500 X	(B)	✓	✓	✓		✓		67
		(A)	✓	✓	✓	✓	✓	333.08	53 %
# 8	200 X	B							
		(A)	✓	✓	✓	✓	✓	175.93	100 %
# 9	100 X	B							
		A							%
#10	X	B							

$$E_{D50} = 638.13$$

$$E_{D2} = 1081.85$$

$$E_{D98} = 194.42$$

$$Q_0 = 1100.34$$

$$a_1 = -9.24$$

$$r^2 = 0.64$$

$$S_{y \cdot x} = 207.28$$

$$S_0 = 169.24$$

$$S_1 = 2.82$$

ONTARIO RESEARCH FOUNDATIONDepartment of Environmental ChemistryODOUR TEST PANEL

Sample #2 stack "Gary"
 sampled July 3 10:49 - 10:55 AM
 no dilution

Date July 3⁴, 1979

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
		(A)							0 %
#1	1000 X	B							
		A		✓	✓	✓	✓	525.64	83 %
#2	500 X	(B)	✓	✓	✓	✓	✓		
		A			✓			824.88	17 %
#3	800 X	(B)	✓		✓		✓		
		(A)	✓		✓		✓	675.26	50 %
#4	700 X	B	✓						
		(A)	✓	✓	✓	✓	✓	523.48	83 %
#5	600 X	B							
		A			✓	✓	✓	1448.57	%
#6	400 X	(B)	✓	✓	✓	✓	✓		100
		A							%
#7	X	B							
		A							%
#8	X	B							
		A							%
#9	X	B							
		A							%
#10	X	B							

$$E_{D50} = 657.26$$

$$E_{D2} = 892.89$$

$$E_{D98} = 457.94$$

$$Q_0 = 901.95$$

$$Q_1 = -4.53$$

$$r^2 = 0.90$$

$$S_{y \cdot x} = 57.09$$

$$S_0 = 62.81$$

$$S_1 = 0.86$$

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Department of Environmental Chemistry

ODOUR TEST PANEL

Sample #3 stack 2

Date July 4, 1979

sampled July 3 1:09-1:23 PM

dilution ~1:5

[1: 7.72]

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
#1	1000X	(A)							0 %
		B							
#2	4576	(A)	✓	✓	✓		✓	3619.21	67 %
	800X	B							
#3	1000X	A							
		(B)						X	
#4	4004	A							
	700X	(B)		✓	✓	✓		4467.9	50 %
#5	2860	(A)	✓	✓	✓	✓		2820.45	83 %
	500X	B							
#6	2288	(A)	✓	✓	✓	✓	✓	2820.45	83 %
	400X	B							
#7	800X	A							
		(B)		✓		✓	✓		
#8	X	A							
		B							
#9	X	A							
		B							
#10	X	A							
		B							

$$E_{D50} = 4467.90$$

$$E_{D.2} = 6864.19$$

$$E_{D98} = 2071.60$$

$$Q_0 = 6964.04$$

$$Q_1 = -49.02$$

$$r^2 = 0.57$$

$$S_{y.x} = 841.34$$

$$S_0 = 2221.39$$

$$S_1 = 30.83$$

ONTARIO RESEARCH FOUNDATIONDepartment of Environmental ChemistryODOUR TEST PANELSample #4 stage 2

Date

July 3, 1979sampled July 3
dilution 1:5

1:41 - 1:48 PM

[1:47.12]

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.	%
		A								0 %
# 1	1000 X	(B)								
		A								%
# 2	500 X	(B)	✓	✓	✓	✓	✓	✓	100	
	5720	(A)				✓			5763	17 %
# 3	1000 X	B	✓			✓			5237	33 %
	5148	(A)	✓			✓			5237	33 %
# 4	900 X	B								
	4576	(A)	✓	✓	✓	✓			4120	67 %
# 5	800 X	B		✓	✓	✓				
	4000	(A)	✓	✓	✓	✓	✓		3594	83 %
# 6	100 X	B								
	2860	A	✓						3594	83 %
# 7	500 X	(B)	✓	✓	✓	✓	✓			
		A								%
# 8	X	B								
		A								%
# 9	X	B								
		A								%
#10	X	B								

$$E_0 50 = 4679$$

$$E_0 2 = 6256$$

$$E_0 98 = 3101$$

$$Q_0 = 6322$$

$$Q_1 = -32.86$$

$$r^2 = 0.81$$

$$S_{y \cdot x} = 555.21$$

$$S_0 = 577.84$$

$$S_1 = 9.22$$

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ODOUR TEST PANEL

Sample #1 Source #3
 Sampled July 4 11:13 - 11:18 Am
 no dilution

Date July 5, 1979

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.	
#1	1000 X	A								
		B								
#2	800 X	A							575.56	
		B					✓	✓		33
#3	600 X	A						✓	719.76	17
		B			✓					
#4	500 X	A			✓	✓		✓	436.46	50
		B		✓			✓	✓		
#5	400 X	A		✓			✓	✓	436.46	50
		B				✓	✓	✓		
#6	200 X	A		✓		✓	✓	✓	269.13	67
		B								
#7	100 X	A		✓		✓	✓	✓	269.13	67
		B		✓						
#8	50 X	A		✓				✓	-28.28	100
		B	✓	✓	✓	✓	✓	✓		
#9	X	A								
		B								
#10	X	A								
		B								

$E_{D50} = 436.46$

$E_{D2} = 854.95$

$E_{D98} = -10.25$

$Q_0 = 872.97$

$a_1 = -9.01$

$r^2 = 0.76$

$S_{y \cdot x} = 148.83$

$S_0 = 136.75$

$S_1 = 2.27$

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ODOUR TEST PANEL

Sample # 2 Source # 3

Date July 5, 1979

sampled July 4 11:24-11:29 Am.
no dilution

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
# 1	1000 X	(A)						✓	670.50
		B							17
# 2	blank X	A							
		B							
# 3	800 X	A						✓	670.50
		(B)							17
# 4	600 X	A						✓	670.50
		(B)							17
# 5	400 X	A						✓	670.50
		B							17
# 6	200 X	A			✓		✓	✓	382.55
		(B)							50
# 7	100 X	A	✓	✓	✓		✓	✓	94.60
		(B)							83
# 8	50 X	A		✓	✓	✓	✓	✓	94.60
		(B)							83
# 9	50 X	A	✓					✓	-53.74
		(B)							100
#10	X	A							
		B							

$E_D 50 = 382.55$

$E_D 2 = 801.39$

$E_D 98 = -36.29$

$Q_0 = 818.84$

$Q_1 = -8.73$

$r^2 = 0.73$

$S_{y \cdot x} = 203.45$

$S_0 = 125.88$

$S_1 = 2.15$

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ODOUR TEST PANEL

Sample # 3 Source #3

Date July 5, 1979

sampled July 4 11:37 - 11:41
and 11:43 - 11:48 Am.
dilution ratio 1:4.7

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
# 1	2000 X	(A)							0
		B						X	
# 2	1000 X	(A)							
		B							
# 3	800 X	(A)							
	2860	B							
		A							
# 4	500 X	(B)					✓		2277 17
	1144	A					✓	✓	
# 5	200 X	(B)		✓	✓	✓	✓	✓	1865 33
	572	(A)		✓	✓	✓	✓	✓	
# 6	100 X	B	✓	✓	✓	✓	✓		579 83
	286	(A)	✓	✓	✓	✓	✓		
# 7	50 X	B							142 100
		A							
# 8	X	B							
		A							
# 9	X	B							
		A							
#10	X	B							

$$ED_{50} = 1428$$

$$ED_2 = 2662$$

$$ED_{98} = 193$$

$$G_0 = 2713.87$$

$$G_1 = -25.72$$

$$r^2 = 0.78$$

$$Sy.X = 663.76$$

$$S_0 = 654.64$$

$$S_1 = 9.69$$

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ODOUR TEST PANEL

Sample #4 Source #3

Date July 6, 1979

Sampled July 5th? 806 to 817
predilution 1:4.7

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.	%
	5720	A								
# 1	1000 X	(B)	✓	✓	✓				2902.24	60 %
	11000	(A)								
# 2	2000 X	B								0 %
	11000	(A)								
# 3	750 X	B								0 %
	4576	(A)	✓		✓				4152.43	40 %
# 4	300 X	B								
	3432	(A)	✓		✓				4152.43	40 %
# 5	600 X	B								
	2288	A								
# 6	400 X	(B)	✓	✓	✓				2902.24	60 %
	1100	A								
# 7	200 X	(B)	✓	✓	✓				2902.24	60 %
	5720	(A)	✓	✓	✓	✓	✓		401.86	100 %
# 8	100 X	B								
	429	(A)	✓	✓	✓	✓	✓		401.86	100 %
# 9	75 X	B								
	286	(A)	✓	✓	✓	✓	✓		409.86	100 %
#10	50 X	B								
	172	(A)	✓	✓	✓	✓	✓		401.86	100 %
	30	(A)								

$$ED_{50} = 3527.33$$

$$ED_{75} = 6527.79$$

$$ED_{90} = 526.38$$

$$Q_0 = 6652.81 \quad S_{y \cdot x} = 1320.33$$

$$Q_1 = -62.51 \quad S_0 = 1366.67$$

$$R^2 = 0.64 \quad S_1 = 17.64$$

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ODOUR TEST PANEL

Sample #1 Source #4
sampled July 5 10:02 to 10:15
no dilution

Date July 6, 1979

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
#1	2000 X	(A)							0 0 %
		B							
#2	1000 X	(A)							0 %
		B							
#3	800 X	A						846.25	40 33 %
		(B)	✓		✓				
#4	400 X	A						548.75	60 53 %
		(B)	✓	✓	✓				
#5	100 X	(A)	✓	✓	✓	✓		251.25	80 67 %
		B							
#6	50 X	(A)	✓	✓	✓	✓	✓	46.25	100 83 %
		B							
#7	30 X	(A)	✓	✓	✓	✓	✓	46.25	100 %
		B							
#8	10 X	(A)	✓	✓	✓	✓	✓	46.25	100 %
		B							
#9	X	A							%
		B							
#10	X	A							%
		B							

$E_{0.50} = 697.50$

$E_{0.2} = 1411.50$

$E_{0.98} = -16.10$

$Q_0 = 1441.25$

$Q_1 = -14.88$

$Q_2 = 0.83$

$S_{y \cdot x} = 308.80$

$S_0 = 196.85$

$S_1 = 2.73$

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ODOUR TEST PANEL

Sample #2 Source #4

Date July 6, 1979.

sampled July 5 10:27-10:37
no dilution

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.	
# 1	2500 X	(A)							0	0 %
		B								
# 2	1000 X	(A)	✓					870.0	20	11 %
		B								
# 3	600 X	A						630.0	40	22 %
		(B)	✓		✓					
# 4	200 X	A						390.0	60	50 %
		(B)	✓	✓		✓				
# 5	100 X	(A)	✓	✓	✓	✓		150.0	80	67 %
		B								
# 6	50 X	(A)	✓	✓	✓	✓	✓	-90.0	100	83 %
		B								
# 7	10 X	(A)								%
		B								
# 8	X	A								%
		B								
# 9	X	A								%
		B								
#10	X	A								%
		B								

$$E_0 50 = 510.0$$

$$E_0 2 = 1086.0$$

$$E_0 98 = -66.00$$

$$a_0 = 1110.0$$

$$a_1 = -12.0$$

$$r^2 = 0.88$$

$$S_{y \cdot x} = 159.16$$

$$S_0 = 166.93$$

$$S_1 = -2$$

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ODOUR TEST PANEL

Sample #3 Source #4

Date July 6, 1979

Sampled July 5 11:05-11:28
dilution 1:3.3

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
#1	2000 X	A (B)							
#2	1000 X	A (B)							
#3	2592 600 X	A (B)	✓		✓	✓		2740.21	20
#4	864 200 X	A (B)	✓			✓		1951.48	40
#5	432 100 X	A (B)	✓	✓	✓	✓		374.03	80
#6	216 50 X	A (B)	✓	✓	✓	✓		374.03	80
#7	130 30 X	A (B)	✓	✓	✓	✓	✓	-419.69	100
#8	43 10 X	A (B)	✓	✓				-410.69	100
#9	X	A B							%
#10	X	A B							%

$$E_{D50} = 1557.12$$

$$E_{D2} = 3450.06$$

$$E_{D98} = -335.82$$

$$Q_0 = 3528.93$$

$$Q_1 = -39.04$$

$$r^2 = 0.85$$

$$S_{y \cdot x} = 780.06$$

$$S_0 = 536.66$$

$$S_1 = 825$$

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ODOUR TEST PANEL

Sample #4 Source #4

Date July 6, 1979

sampled July 5 11:27-11:29
dilution 1:3.3

Panel Member Response

Test #	Dilution		#1	#2	#3	#4	#5	#6	No. of Correct Pos.
# 1	4320	(A)	(✓)						0 %
	1000 X	B							
# 2	2592	(A)			(✓)				0 %
	600 X	B							
# 3	864	A	✓	✓		✓		1361.30	%
	700 X	(B)	✓	✓		✓			60 %
# 4	432	A						552.56	%
	100 X	(B)	✓	✓	✓	✓			80 %
# 5	216	(A)	✓	✓	✓	✓	✓	-256.19	150 %
	50 X	B							
# 6	2592	A						2978.79	20 %
	600 X	(B)	✓						
# 7		A							%
	X	B							
# 8		A							%
	X	B							
# 9		A							%
	X	B							
# 10		A							%
	X	B							

$$ED_{50} = 1765.67$$

$$ED_2 = 3706.66$$

$$ED_{98} = -175.31$$

$$a_0 = 3787.53$$

$$a_1 = -210.44$$

$$r^2 = 0.92$$

$$Sy.x = 553.15$$

$$S_0 = 2125.97$$

$$S_1 = 6.67$$

Particulate Emission Determination:

Particulate (aerosol) emission measurements were conducted in conjunction with the total aldehydes and organic acids emission measurements. The detailed procedure and a brief description of the sampling train are given below.

A schematic of the EPA method 5 sampling train is shown in Figure B-1. The stack gas is withdrawn isokinetically from the stack via a goose-neck nozzle and through a heated probe (to prevent condensation) to the heated hot box. The hot box (usually maintained at 135°C) contained a filter holder and a preconditioned and preweighted glass fibre filter (sometimes preceded by a cyclone) to capture the particulates. Following filtration, the stack gas passes through a series of four impingers immersed in an ice bath. Their purpose is to remove moisture by condensation. This permits the determination of stack gas moisture content and also protects downstream components from excess moisture. Normally the first and second impingers contain distilled water (150 ml each), the third is empty and the fourth contains 200 g of silica gel. However, in this case the first two impingers each contain 150 ml of either 5% NaOH or 1% NaHSO₃ for the measurements of organic acids or total aldehydes, depending on the pollutants measured. The filtered and dried stack gas is drawn through the umbilical cord to the module.

The control module consists of a leak free pump with a by-pass valve, a dry gas meter and a temperature monitoring system. The temperature monitoring system measures the temperatures of the stack gas, the probe, the oven, the impinger outlet and the dry gas meter inlet and outlet. The controls for the probe and hot box heaters are also incorporated in the control module.

Isokinetic sampling is maintained by relating the sampling rates, shown by an orifice meter, to the stack gas velocities. A mathematical relationship is established by a set of preliminary

tests in which the stack gas moisture, stack gas molecular weight and stack gas temperature are determined. Stack gas velocities are continually measured with a calibrated pitot tube, and the sample flow rates are continually adjusted to be maintained at $100 \pm 10\%$.

During the tests, the stack or duct is sampled at a prescribed number of sampling points, on two traverses (90° apart). In this way, a representative sample is obtained.

The sample recovery is deviated from the Ontario Source Testing Code procedure. The probe, filter housing, impinger connectors and impingers are rinsed with either 5% NaOH or 1% NaHSO₃ depending on the pollutants measured. All washings are added to the impinger solution for the analyses of either organic acids or total aldehydes. The filter is recovered and placed in a prenumbered petri dish and transported to the SAU laboratory for weight determination.

The glass fibre filters are preconditioned by desicating at 21.1°C for 24 hours. The filters are then weighed to the nearest 0.5 mg with a Sartorius balance in an air conditioned room and placed in a numbered petri dish. The spent filters are desicated at 21.1°C for 24 hours and the weight gains are measured on the same Sartorius balance. The weight differentials are recorded and the particulate concentrations and emission rates are calculated according to the equation outlined in the Ontario Source Testing Code.

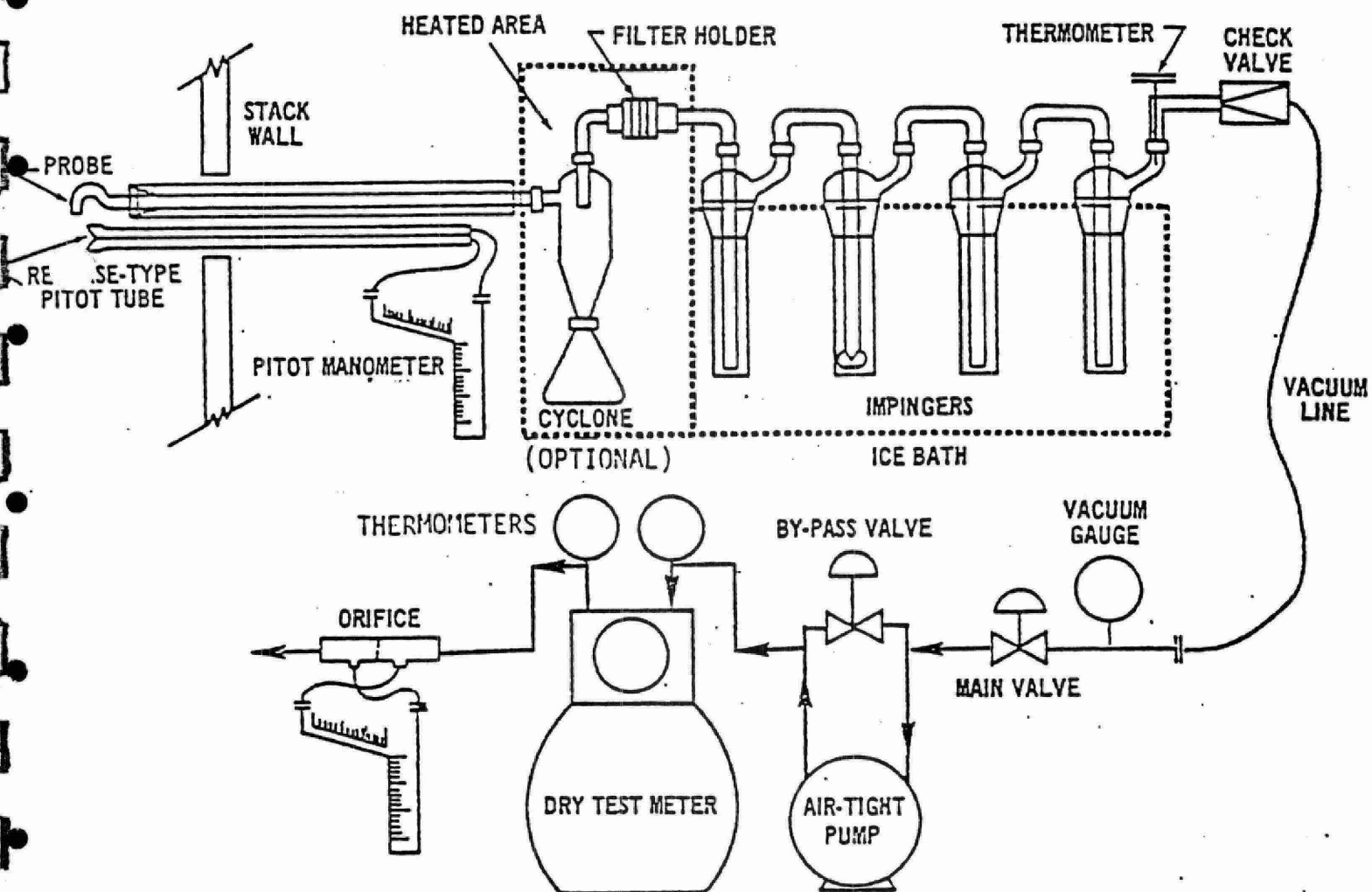
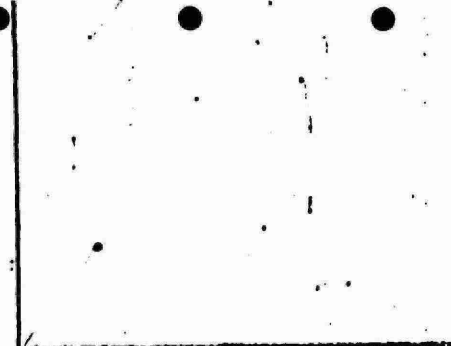


FIGURE B-1 SAMPLING TRAIN

Location 6th - Small Ref
 Operator J. Mc
 Date Nov. 17
 Run No. 11
 Sample Box No. C11
 Central Module No.
 Meter (ΔH)
 C Factor

Schematic of Sta



Cross Section
 Assumed Moisture (%). 2.0
 Heater Box Setting (°F). 200
 Probe Length (in.). 6
 Nozzle Diameter (in.). .25
 Nozzle Area (Sq. in.).
 STATIC PRESSURE 0.02" Hg

VAC → 6" Hg

Traverse Point Number	Sampling Time (0) Min.	Stack Temp. Ts (°F)	Velocity Head (ΔPs)	Velocity (Ft./sec)	Orifice Pressure Diff. (ΔH) in. H ₂ O	Gas Sample Volume (Vm) Cu. Ft.	Gas Temperature At Dry Gas Meter		Sample Box Temp. of	Probe Temp. (°F)
							Inlet (Tm in.) OF	Outlet (Tm out) OF		
1-A	0	133	1.1		6.0	187.02	48	48	176/56	141
	4	132	1.1		3.20	192.865	48	50		
	8	131	1.1		3.46	195.867	51	48		
	12	130	1.1		3.6	199.723	51	50		
2-A	16	126	1.1		3.8	204.125	52	52		
		126	1.0		3.9	208.431	51	53		
		126	1.0		3.7	212.367	50	54		
		125	1.1		3.5	217.156	51	54		
						218.128				
7-B	0	129	.82		2.8	221.29	47	51	157/54	200
	4	128	.84		2.8	224.895	47	51		
	8	119	.86		3.0	228.552	48	51		
	12	119	.86		2.9	232.228	48	51		
2-B	16	127	.94		3.0	235.990	50	52		
	20	125	.94		3.1	239.821	49	52		
	24	125	.84		3.1	243.757	49	53		
	28	124	.94		3.1	247.745	50	53	150/48	140
	32					251.711				

PLANT G.M. 204
 LOCATION Yellow (W.B.)
 TEST Adipic acid #1

DATE Nov. 17 1977
 OPERATORS _____
 ANALYST _____

MOISTURE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF MOISTURE (gm.)
IMPINGER # 1	669.2	660.9	8.3
IMPINGER # 2	683.2	679.6	3.6
IMPINGER # 3	512.6	509.8	2.8
IMPINGER # 4	712.2	699.6	12.6
TOTAL			27.3
MOISTURE VOLUME			ml.

14.7

PARTICULATE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF PARTICULATE (gm.)
✓ FILTER (1)	0.4054	0.4010	0.0044
BEAKER WITH (PROBE - NOZZLE - CYCLONE) WASHINGS			
CYCLONE FLASK	—	—	—
BEAKER WITH (IMPINGER FILTER-HOLDER) CONTENTS AND WASHINGS			
TOTAL (gm.)			
PARTICULATES IN (mg.)			4.4

49
 449 ml.
 449 ml.

STACK SAMPLING REPORT

CONTRACT: GENERAL MOTORS
CITY: OSHKOSH
LOCATION: PEARSON #4 STACK
TEST DATE: TEST #1-NOV.17.77

NUMBER OF TRAVERSES: 2.00

PT	DH H2O	WF H2O	TS °F	TH1 °F	TH2 °F	TAVG °F	VS FTS	MD LEAK-CH. OR TR. END	IGHV FTS	TIME MIN
1	6.00	1.100	133.00	48.0	48.0	48.0	187.00	0.00	5.05	4.0
2	3.20	1.100	132.00	48.0	50.0	49.0	192.00	0.00	3.80	4.0
3	2.40	1.100	131.00	51.0	48.0	49.5	195.00	0.00	4.00	4.0
4	3.00	1.100	130.00	51.0	50.0	50.5	199.00	0.00	4.20	4.0
5	3.00	1.100	130.00	52.0	52.0	52.0	204.10	0.00	4.31	4.0
6	3.30	1.000	128.00	51.0	53.0	52.0	208.40	0.00	4.44	4.0
7	3.70	1.000	128.00	50.0	54.0	52.0	212.80	0.00	4.29	4.0
8	3.50	1.100	129.00	51.0	54.0	52.5	217.10	0.00	4.12	4.0
9	2.80	0.820	129.00	47.0	51.0	49.0	221.20	221.20	3.62	4.0
10	2.80	0.840	128.00	47.0	51.0	49.0	224.90	0.00	3.66	4.0
11	3.30	0.800	119.00	48.0	51.0	49.5	228.55	0.00	3.68	4.0
12	2.90	0.800	115.00	48.0	51.0	49.5	232.20	0.00	3.70	4.0
13	3.00	0.940	127.00	50.0	52.0	51.0	235.80	0.00	3.80	4.0
14	3.10	0.940	125.00	49.0	52.0	50.5	239.80	0.00	3.94	4.0
15	3.10	0.940	125.00	49.0	53.0	51.0	243.70	0.00	3.99	4.0
16	3.10	0.940	126.00	50.0	53.0	51.5	247.75	0.00	3.97	4.0
							251.71			

AVG. 3.43 0.90 127.31 49.4 51.4 50.4 4.04

STACK GAS PRESSURE: PEAR= 29.12 IN HG
P STAT= 0.02 IN HG, 0.37 IN H2O
P STACK= 29.14 IN HG

STACK GAS MOISTURE: 1.92 WATER VOLUME IN IMPINGER= 14.70 ML
WATER VOLUME IN SILICA GEL= 13.60 ML
MOISTURE VOLUME (TRAIN)= 1.29 SCF
MOISTURE FRACTION, BWS = 0.02

SATURATION MOISTURE: 14.55
RELATIVE HUMIDITY: 12.23
SAMPLING TIME: 64.00
SAMPLE VOLUME: 65.94

STACK GAS COMPOSITION %CO2= 0.00 %O2= 21.00 %CO= 0.00
%N2= 79.00 %SO2= 0.00

STACK GAS MOLECULAR WEIGHT: DRY MW-MD 28.84
WET MW-MW= 28.63
%EXC. AIR=-14583.33

TRAIN COMPONENTS SPECS: PITOT COEFFICIENT CV= 0.8120
NOZZLE DIAMETER= 0.2500 INCHES
METER CORR. FACTOR = 1.0000

STACK DIMENSIONS: DIAMETER= 12.000 INCHES 0.000 INCHES
AREA = 0.785 SQFT

PRODUCTION RATE: 4.00 TRUCK BODIES/M1

% ISOTHERMATIC

POINT	DH H2O	DP H2O	TS °F	VS FT SEC	IGHV FTS	DGMG FTS/MIN	Q
1	6.00	1.10	133.0	61.0	5.05	1.24	121.55
2	3.20	1.10	132.0	61.0	3.80	0.90	98.71
3	2.40	1.10	131.0	61.0	4.00	1.01	98.64
4	3.00	1.10	130.0	61.1	4.20	1.05	99.89
5	3.00	1.10	130.0	61.4	4.31	1.06	102.60
6	3.30	1.00	128.0	61.4	4.44	1.07	102.60
7	3.70	1.00	128.0	60.1	4.29	1.07	100.20
8	3.50	1.10	129.0	60.9	4.12	1.03	97.21
9	2.80	0.82	129.0	59.7	3.62	0.90	99.54
10	2.80	0.84	128.0	59.3	3.66	0.91	99.41
11	3.30	0.80	119.0	59.5	3.68	0.92	97.95
12	2.90	0.86	119.0	59.7	3.70	0.94	100.21
13	3.00	0.94	127.0	59.7	3.80	0.96	98.02
14	3.10	0.94	125.0	56.3	3.94	0.98	100.66
15	3.10	0.94	125.0	56.3	3.99	1.00	101.89
16	3.10	0.94	126.0	56.3	3.97	0.99	101.34

PRODUCTION RATE : 4.00 TRUCK BODIES/H

% ISOKINETIC

POINT	DN H2O	DP H2O	TS °F	VS FT/SEC	DUR. FT3	DUR. FT3/MIN	
1	6.00	1.10	133.0	61.0	5.05	1.22	121.55
2	3.20	1.10	132.0	61.2	3.80	0.95	93.71
3	3.40	1.10	131.0	61.2	4.06	1.01	90.64
4	3.60	1.10	130.0	61.1	4.20	1.05	99.63
5	3.80	1.10	136.0	61.4	4.31	1.08	101.89
6	3.80	1.00	136.0	61.4	4.31	1.08	101.89
7	3.70	1.00	126.0	56.3	4.27	1.00	97.21
8	3.50	1.10	125.0	56.3	4.12	1.03	99.54
9	2.80	0.82	129.0	52.7	3.60	0.90	99.41
10	2.80	0.84	128.0	52.7	3.60	0.91	97.95
11	3.00	0.86	119.0	56.3	3.60	0.92	100.21
12	2.90	0.86	119.0	56.3	3.76	0.94	93.02
13	3.00	0.94	127.0	56.3	3.83	0.96	100.66
14	3.10	0.94	125.0	56.3	3.94	0.98	101.89
15	3.10	0.94	125.0	56.3	3.99	1.00	101.32
16	3.10	0.94	126.0	56.3	3.97	0.99	

SUMMARY OF EMISSION TESTS

COMPANY: GENERAL MOTORS
LOCATION: REFLOW #4 STACK
CITY: OSHAWA

TEST & DATE: TEST #1 NOV. 17/77
TDA REPORT#: -
DATE REPORT REC'D:
CONSULTANT REPORT #:

EMISSION COMPONENT: PARTICULATES (IMPRINGER EXCLUDED)

GAS VELOCITY	GAS TEMP.	GAS MOIS.	GAS FLOW	EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
FPS	°F	%	DSCFM	LB/HR	GR/FT3	LB/TRUCK BODIES
57.6	127.3	1.92	2339.16	2.065E-02	1.030E-03	5.162E-03
MPS	°C	%	DSCMH	GM/SEC	GM/M3	KG/TRUCK BODIES
17.6	53.0	1.92	66.22	2.602E-03	2.356E-03	2.342E-03

EMISSION COMPONENT: PARTICULATES (IMPRINGERS INCLUDED)

EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
LB/HR	GR/FT3	LB/TRUCK BODIES
2.065E-02	1.030E-03	5.162E-03
GM/SEC	GM/M3	KG/TRUCK BODIES
2.602E-03	2.356E-03	2.342E-03

COMPONENT DISTRIBUTION IN SAMPLING TRAIN

	PROBE	CYCLONE	FILTER	IMPRINGERS	TOTAL
PARTICULATES (MG)	0.0000	0.0000	4.4000	0.0000	4.4000
% OF TOTAL PART	0.0000	0.0000	100.0000	0.0000	100.0000

ISOKINETIC & SAMPLING DATA SUMMARY

	AVERAGE ISOKINETICS 101.49	SAMPLING MIN. 64.00	SAMPLE VOLUME (SCM) 1.83		
READINGS	SUB.ISO	SUPERISO	NON.ISO	%WITHIN ISO	ACCEPTILITY FACTOR
16	0	1	1	94	95% ISO-110 WELL WITH...
		ISO 15	NONISO 1	94	85% ISO-115 WELL WITH...

Location GM-5 small JMG
 Operator JMG
 Date Nov 17/77
 Run No. AC10 #1
 Sample Box No. RAC
 Control Module No.
 Meter (ΔH)
 C Factor 0.810

Schematic of St



Cross Section

Assumed Moisture (%). 2.9
 Heater Box Setting (°F). 250
 Probe Length (in.). 16'
 Nozzle Diameter (in.). .25
 Nozzle Area (Sq. in.). 0.024
 STATIC PRESSURE

$V_{ac} \approx 5" H_2$

Transverse Point Number	Sampling Time (θ) Min.	Stack Temp. Ts (°F)	Velocity Head (ΔPs)	Velocity (Ft./sec)	Orifice Pressure Diff. (ΔH) in. H ₂ O	Gas Sample Volume (Vm) Cu. Ft.	Gas Temperature At Dry Gas Meter		Sample Box Temp. °F	Probe Temp. (°F)
							Inlet (Tm in.) °F	Outlet (Tm out) °F		
1-A	0	120	1.2		3.8	288.507	41	41	250/50	200
	4	119	1.2		4.0	292.705	50	42		
	8	120	1.2		4.0	297.177	56	42		
	12	120	1.2		4.0	301.544	60	43		
2-A	16	117	1.1		4.0	306.020	62	44		
	20	116	1.0		3.9	310.571	64	45		
	24	120	1.0		3.8	315.041	64	46		
	28	122	1.0		3.7	319.388	67	57		
	32					323.670				
1-B	0	126	1.2		4.0	323.738	47	45		
	4	127	1.2		4.5	328.132	58	46		
	8	138	1.2		4.2	332.578	62	46		
	12	128	1.2		4.3	336.967	64	46		
2-B	16	110	.85		3.7	341.390	65	47		
	20	106	.85		3.7	345.491	55	47		
	24	113	.83		3.6	349.567	52	46		
	28	113	.83		3.5	353.567	57	46		
	32					357.493				

FIELD SAMPLING DATA SHEET

PLANT Stack #0
 LOCATION Stack Reflow (W.B.)
 TEST Acid # 1

DATE NOV 17/77
 OPERATORS _____
 ANALYST _____

MOISTURE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF MOISTURE (gm.)
IMPINGER # 1	659.8	653.0	6.8
IMPINGER # 2	291.5	282.9	8.6
IMPINGER # 3	510.5	509.1	1.4
IMPINGER # 4	741.6	725.1	16.5
TOTAL			33.3
MOISTURE VOLUME.			ml.

PARTICULATE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF PARTICULATE (gm.)
FILTER (2)	.4082	0.4027	0.0055
BEAKER WITH (PROBE - NOZZLE - CYCLONE) WASHINGS			
CYCLONE FLASK	—	—	—
BEAKER WITH (IMPINGER FILTER-HOLDER) CONTENTS AND WASHINGS			
TOTAL (gm.)			
PARTICULATES IN (mg.)			5.5

Washings
 194
 165
 24

740
 160
 158

sinusoidal wave, $\omega = 2\pi f$, $f = 1/T$.

Publisher: ...
 Editor: ...
 Layout: ...
 ISBN: ...

NUMBER OF TRAVEL DATES: 2.00

PT	DH H2O	DP H2O	TS °F	TH1 °F	THO °F	THC °F	VM FT3	VMLEAK-CH. OR TR.END	DCMV FT3	TIME MIN
1	1.00	1.000	120.00	41.0	41.0	41.0	288.51	0.00	4.28	4.0
2	4.00	1.000	118.00	50.0	42.0	42.0	292.71	0.00	4.47	4.0
3	4.00	1.000	120.00	56.0	42.0	42.0	297.18	0.00	4.37	4.0
4	4.00	1.000	120.00	60.0	43.0	51.0	301.54	0.00	4.58	4.0
5	4.00	1.000	117.00	62.0	44.0	51.0	306.11	0.00	4.45	4.0
6	3.00	1.000	118.00	64.0	45.0	54.0	310.57	0.00	4.47	4.0
7	1.00	1.000	120.00	64.0	46.0	55.0	315.04	0.00	4.35	4.0
8	3.70	1.000	123.00	67.0	57.0	62.0	319.39	0.00	4.28	4.0
9	4.00	1.000	124.00	47.0	45.0	46.0	323.74	323.67	4.39	4.0
10	4.50	1.000	127.00	58.0	48.0	52.0	328.13	0.00	4.45	4.0
11	4.20	1.000	138.00	62.0	48.0	54.0	332.58	0.00	4.39	4.0
12	4.50	1.000	128.00	64.0	46.0	55.0	336.97	0.00	4.42	4.0
13	3.70	0.850	110.00	65.0	47.0	56.0	341.39	0.00	4.10	4.0
14	3.70	0.850	106.00	55.0	47.0	51.0	345.48	0.00	4.08	4.0
15	3.00	0.830	113.00	52.0	46.0	49.0	349.57	0.00	4.00	4.0
16	3.50	0.810	113.00	57.0	46.0	51.0	353.57	0.00	3.93	4.0

PER. 3.42 1.07 118.69 52.8 45.6 51.7 4.34

```

STACK GAS FREQUENCY :      PBAP= 29.12      IN HG
                          P STAT= 0.00      IN HG, 0.27      IN H2O
                          P STACK= 29.14      IN HG

```

[illegible]

SATURATION MOISTURE: 11.81
RELATIVE HUMIDITY: 10.63
SAMPLING TIME: 04.00
SAMPLE VOLUME : 70.17

STACK GAS COMPOSITION	CO2= 0.00	CO= 21.00	NO= 0.00
	CH4= 79.00	H2O2= 0.00	

STACK GAS MOLECULAR WEIGHT: DRY MW-MD 28.84
NET MW-MN= 28.66
NEMC AIR=-14563.33

```

TRAIN COMPONENTS - SPECS:  PILOT COEFFICIENT CP= 0.8100
                           NOZZLE DIAMETER   = 0.2500  INCHES
                           METER CORR. FACTOR = 1.0000

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STACK ELEMENTS = DIAMETER= 12.000 INCHES 0.000 INCHES
AREA = 0.785 SQFT

PRODUCT UNIT PRICE : 4.00 TRUCK BODIES/M1

2. ISOINETIC

POINT	SH H2O	DF H2O	TS °F	VS FT/SEC	DGMV FT/S	DGMO FT/3MIN	TA
1	3.80	1.20	120.0	63.2	4.26	1.05	97.04
2	4.00	1.20	119.0	63.1	4.47	1.12	102.31
3	4.00	1.20	120.0	63.3	4.37	1.09	99.41
4	4.00	1.20	120.0	63.2	4.58	1.14	103.66
5	4.00	1.10	117.0	60.3	4.45	1.11	104.73
6	4.00	1.20	120.0	63.2	4.35	1.09	100.71
7	3.80	1.20	120.0	63.7	4.35	1.09	107.08
8	3.70	1.00	122.0	57.8	4.28	1.07	104.22
9	4.00	1.20	126.0	63.5	4.39	1.10	101.13
10	4.50	1.20	137.0	63.5	4.45	1.11	101.34
11	4.20	1.20	138.0	64.1	4.39	1.10	100.51
12	4.30	1.20	138.0	63.6	4.42	1.11	100.27
13	3.70	0.85	110.0	52.7	4.10	1.03	100.38
14	3.70	0.85	106.0	52.5	4.08	1.02	100.40
15	3.60	0.83	113.0	52.2	4.00	1.00	100.71
16	3.50	0.83	113.0	52.2	3.93	0.98	100.11

PRODUCTION RATE : 4.00 TRUCK BODIES/M1

% ISOINETIC

POINT	DH H2O	DP H2O	TS °F	VS FT/SEC	DGM FT3	DGM FT3/MIN	SI
1	3.80	1.20	120.0	63.2	4.20	1.05	97.04
2	4.00	1.20	119.0	63.1	4.40	1.12	102.31
3	4.00	1.20	120.0	63.2	4.37	1.09	99.41
4	4.00	1.20	120.0	63.2	4.50	1.14	103.66
5	4.00	1.10	117.0	60.9	4.45	1.11	104.79
6	3.70	1.00	122.0	57.3	4.35	1.09	107.08
7	3.80	1.00	120.0	57.7	4.35	1.09	107.08
8	3.70	1.00	122.0	57.3	4.28	1.07	104.22
9	4.00	1.20	126.0	63.5	4.39	1.10	101.13
10	4.50	1.20	127.0	63.5	4.45	1.11	101.34
11	4.20	1.20	128.0	64.1	4.39	1.10	100.51
12	4.20	1.20	128.0	63.6	4.42	1.11	100.27
13	3.70	0.85	110.0	52.7	4.00	1.00	108.38
14	3.70	0.85	106.0	52.5	4.00	1.00	108.40
15	3.60	0.80	110.0	52.3	4.00	1.00	108.71
16	3.50	0.75	112.0	52.2	3.90	0.98	106.15

SUMMARY OF EMISSION TESTS

COMPANY: GENERAL MOTORS
 LOCATION: REFLOW #4 STACK
 CITY: OSHAWA
 TEST # DATE: TEST #2100V.17-77
 TDA REPORT#: -
 DATE REPORT REC'D:
 CONSULTANT REPORT #:

EMISSION COMPONENT: PARTICULATES (IMPRINGER EXCLUDED)

GAS VELOCITY	GAS TEMP.	GAS MOIS.	GAS FLOW	EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
FPS	°F	%	DSCFH	LB/HR	GR/FT3	LB/TRUCK BODIES
59.4	119.7	2.20	2437.09	2.527E-02	1.210E-03	6.318E-03
NPS	°C	%	DSCMH	GM/SEC	GM/M3	KG/TRUCK BODIES
18.1	48.7	2.20	68.99	3.184E-03	2.768E-03	2.866E-03

EMISSION COMPONENT: PARTICULATES (IMPRINGERS INCLUDED)

EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
LB/HR	GR/FT3	LB/TRUCK BODIES
2.527E-02	1.210E-03	6.318E-03
GM/SEC	GM/M3	KG/TRUCK BODIES
3.184E-03	2.768E-03	2.866E-03

COMPONENT DISTRIBUTION IN SAMPLING TRAIN

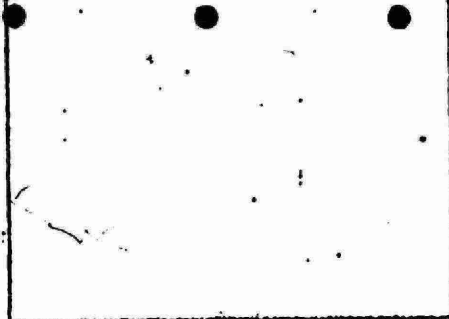
	PROBE	CYCLONE	FILTER	IMPRINGERS	TOTAL
PARTICULATES (MG)	0.0000	0.0000	5.5000	0.0000	5.5000
% OF TOTAL PART	0.0000	0.0000	100.0000	0.0000	1

ISOINETIC & SAMPLING DATA SUMMARY

READINGS	SUB.ISO	SUPERISO	NON.ISO	WITHIN ISO	ACCEPTABLE FACIL
16	0	0	0	100	95
		ISO	NONISO		
		12	5		

Operator JA
 Date Nov 17/77
 Run No. ALDE #2
 Sample Box No. C-1
 Control Module No.
 Meter (ΔH₂)
 C Factor 0.812

Schematic of S



Cross Section

Assumed Moisture (%) 20
 Heater Box Setting (°F) 300
 Probe Length (in.) 6'
 Nozzle Diameter (in.) 1/2
 Nozzle Area (Sq. in.)
 STATIC PRESSURE

VAC 330" Hg

FIELD SAMPLING DATA SHEET CHART

Inverse Point Number	Sampling Time (θ) Min.	Stack Temp. Ts (°F)	Velocity Head (ΔPs)	Velocity (Ft./sec)	Orifice Pressure Diff. (ΔH) in. H ₂ O	Gas Sample Volume (Vm) Cu. Ft.	Gas Temperature At Dry Gas Meter		Sample Box Temp. °F	Pro Temp. (°F)
							Inlet (Tm in.) °F	Outlet (Tm out) °F		
1-A	0	319.325	.51		1.32	251.800	41	40	290/56	20
	4	324	.51		1.50	254.038	42	42		
2-A	8	321	.49		1.55	256.461	43	43		
	12	321	.50		1.6	258.834	43	45		
3-A	16	323	.46		1.3	261.281	44	48	215/50	330
	20	322	.46		1.3	263.664	44	50		
4-A	24	321	.435		1.4	265.995	45	52		
	28	316	.42		1.3	268.338	45	53		
	32					270.693				
1-B	0	322	.52		1.4	270.693	45	56	283/44	32
	4	323	.52		1.5	273.095	45	56		
2-B	8	320	.49		1.5	275.566	45	57		
	12	322	.47		1.4	278.080	46	58		
3-B	16	320	.46		1.4	280.510	46	58		
	20	321	.46		1.3	283.00	46	59		
4-B	24	319	.41		1.3	288.450	47	60		
	28	322	.41		1.2	287.863	46	60	282/46	21
	32					290.163				

<u>Washing</u>	<u>Imp.</u>
190	320
188	
33	

15.250% 15.167%

513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000, 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011, 1012, 1013, 1014, 1015, 1016, 1017, 1018, 1019, 1020, 1021, 1022, 1023, 1024, 1025, 1026, 1027, 1028, 1029, 1030, 1031, 1032, 1033, 1034, 1035, 1036, 1037, 1038, 1039, 1040, 1041, 1042, 1043, 1044, 1045, 1046, 1047, 1048, 1049, 1050, 1051, 1052, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1072, 1073, 1074, 1075, 1076, 1077, 1078, 1079, 1080, 1081, 1082, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1101, 1102, 1103, 1104, 1105, 1106, 1107, 1108, 1109, 1110, 1111, 1112, 1113, 1114, 1115, 1116, 1117, 1118, 1119, 1120, 1121, 1122, 1123, 1124, 1125, 1126, 1127, 1128, 1129, 1130, 1131, 1132, 1133, 1134, 1135, 1136, 1137, 1138, 1139, 1140, 1141, 1142, 1143, 1144, 1145, 1146, 1147, 1148, 1149, 1150, 1151, 1152, 1153, 1154, 1155, 1156, 1157, 1158, 1159, 1160, 1161, 1162, 1163, 1164, 1165, 1166, 1167, 1168, 1169, 1170, 1171, 1172, 1173, 1174, 1175, 1176, 1177, 1178, 1179, 1180, 1181, 1182, 1183, 1184, 1185, 1186, 1187, 1188, 1189, 1190, 1191, 1192, 1193, 1194, 1195, 1196, 1197, 1198, 1199, 1200, 1201, 1202, 1203, 1204, 1205, 1206, 1207, 1208, 1209, 1210, 1211, 1212, 1213, 1214, 1215, 1216, 1217, 1218, 1219, 1220, 1221, 1222, 1223, 1224, 1225, 1226, 1227, 1228, 1229, 1230, 1231, 1232, 1233, 1234, 1235, 1236, 1237, 1238, 1239, 1240, 1241, 1242, 1243, 1244, 1245, 1246, 1247, 1248, 1249, 1250, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, 1263, 1264, 1265, 1266, 1267, 1268, 1269, 1270, 1271, 1272, 1273, 1274, 1275, 1276,

100% Fe³⁺ 100% Zn²⁺ 50% Fe³⁺ 50% Zn²⁺

$$14.1 \pm 0.015; 15.0 \pm 0.015; 16.0 \pm 0.015; 17.0 \pm 0.015$$

3.00

FT	1m H2O	5P H2O	1S °F	TM1 °F	TM0 °F	TAVG °F	MD FT3	MR:LEAD -CH. OR TLEAD	DGMV FT3	TIME MIN
1	1.32	0.510	325.00	41.0	40.0	40.5	251.80	0.00	2.24	4.0
2	1.50	0.510	324.00	42.0	42.0	42.0	254.04	0.00	2.42	4.0
3	1.55	0.470	321.00	43.0	43.0	43.0	256.47	0.00	2.37	4.0
4	1.60	0.500	321.00	43.0	45.0	44.0	258.83	0.00	2.45	4.0
5	1.30	0.460	323.00	44.0	48.0	46.0	261.20	0.00	2.38	4.0
6	1.30	0.460	323.00	44.0	50.0	47.0	263.66	0.00	2.32	4.0
7	1.40	0.435	321.00	45.0	52.0	49.5	265.94	0.00	2.35	4.0
8	1.30	0.420	318.00	45.0	53.0	49.0	268.34	0.00	2.35	4.0
9	1.40	0.520	322.00	45.0	56.0	50.5	270.63	270.63	2.40	4.0
10	1.50	0.520	323.00	45.0	56.0	50.5	273.10	0.00	2.47	4.0
11	1.50	0.480	320.00	45.0	57.0	51.0	275.57	0.00	2.51	4.0
12	1.40	0.470	323.00	46.0	58.0	52.0	278.08	0.00	2.43	4.0
13	1.40	0.460	320.00	46.0	58.0	53.0	280.51	0.00	2.49	4.0
14	1.30	0.460	321.00	46.0	59.0	52.5	283.00	0.00	2.45	4.0
15	1.30	0.410	319.00	47.0	60.0	53.5	285.45	0.00	2.41	4.0
16	1.30	0.410	322.00	46.0	60.0	53.0	287.86	0.00	2.30	4.0

AVER.	1.39	0.47	321.38	44.6	52.3	48.4	2.40
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STACK GAS PRESSURE :      PBAR= 29.12    IN HG
                        P STAT= 0.01    IN HG, 0.14    IN H2O
                        P STACK= 29.13    IN HG

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STAD: GR1 moisture: 6.07	WATER VOLUME IN IMPREGERS= 18.30	ML
	WATER VOLUME IN SILICA GEL= 7.00	ML
	MOISTURE VOLUME (TRAIN) = 1.24	SCF
	MOISTURE FRACTION, BWG = 0.03	

SATURATION MOISTURE: 638.87
RELATIVE HUMIDITY: 0.48
SAMPLING TIME: 64.00
SAMPLE VOLUME : 39.05

STACK GAS COMPOSITION	CO2= 0.00	NO2= 21.00	NO= 0.00
	CH4= 79.00	SO2= 0.00	

STACK GAS MOLE FLOW WEIGHT: DRY MW-MD= 28.84
WET MW-MW= 28.51
%ENC. AIR=-14583.33

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TRAIN COMPONENTS SPECS:  PITOT COEFFICIENT CP= 0.8100
                          NOZZLE DIAMETER = 0.2500 INCHES
                          METER CORR. FACTOR = 1.0000

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STAG: 217-501-1000 DIAMETER= 24.000 HES: 0.000 INCHES
 4566 = 3.1-10 3.0FT

PRODUCT NAME: **TRUCK HOODS**

2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 2681, 26

POINT	W. COG	DE HCO	TS '7	W. COG	DE HCO	TS '7	W. COG	DE HCO	TS '7
1	1.52	0.51	324.0	1.52	0.50	324.0	1.52	0.50	324.0
2	1.50	0.51	324.0	1.50	0.51	324.0	1.50	0.51	324.0
3	1.55	0.49	321.0	1.55	0.49	321.0	1.55	0.49	321.0
4	1.60	0.50	321.0	1.60	0.50	321.0	1.60	0.50	321.0
5	1.50	0.48	323.0	1.50	0.48	323.0	1.50	0.48	323.0
6	1.45	0.46	321.0	1.45	0.46	321.0	1.45	0.46	321.0
7	1.40	0.44	321.0	1.40	0.44	321.0	1.40	0.44	321.0
8	1.40	0.41	316.0	1.40	0.41	316.0	1.40	0.41	316.0
9	1.40	0.52	322.0	1.40	0.52	322.0	1.40	0.52	322.0
10	1.57	0.53	323.0	1.57	0.53	323.0	1.57	0.53	323.0
11	1.5	0.49	320.0	1.5	0.49	320.0	1.5	0.49	320.0
12	1.4	0.47	323.0	1.4	0.47	323.0	1.4	0.47	323.0
13	1.40	0.46	320.0	1.40	0.46	320.0	1.40	0.46	320.0
14	1.40	0.46	321.0	1.40	0.46	321.0	1.40	0.46	321.0
15	1.3	0.41	319.0	1.3	0.41	319.0	1.3	0.41	319.0
16	1.3	0.41	323.0	1.3	0.41	323.0	1.3	0.41	323.0

PRODUCTION RATE 7400 TRUCK BODIES/H

2. ISOKINETIC

POINT	DR H2O	DP H2O	TS °F	VS ft/sec	DOH ft	ELIP Factor	Wt
1	1.33	0.51	325.0	46.1	2.04	0.16	32.29
2	1.53	0.51	324.0	46.1	2.41	0.31	39.61
3	1.65	0.49	321.0	47.0	2.33	0.50	49.18
4	1.68	0.50	321.0	47.0	2.40	0.71	61.00
5	1.80	0.48	323.0	45.1	2.70	0.92	70.00
6	1.50	0.46	322.0	45.0	2.20	0.70	50.00
7	1.40	0.44	321.0	44.8	2.30	0.59	40.17
8	1.30	0.40	316.0	43.4	2.30	0.59	40.49
9	1.40	0.52	312.0	40.0	2.40	0.57	36.01
10	1.50	0.52	311.0	40.0	2.40	0.57	36.86
11	1.50	0.49	320.0	47.0	2.50	0.71	40.31
12	1.50	0.47	318.0	42.1	2.50	0.61	31.87
13	1.50	0.46	320.0	47.0	2.50	0.71	40.38
14	1.50	0.40	314.0	39.0	2.50	0.71	40.11
15	1.50	0.41	314.0	39.0	2.50	0.71	40.76
16	1.50	0.41	314.0	39.0	2.50	0.71	40.98

SUMMARY

EMISS

ES

COMPANY: GENERAL MOTORS
LOCATION: ELRO #3 STAGE
CITY: OSHAWA

TEST & DATE:
TDR REPORTS:
DATE REPORT: 11/14/64
CONSULTANT: DEPT. 11

EMISSION COMPONENT: PARTICULATES

(IMPROVING EMISSIONS)

GAS VELOCITY	GAS TEMP.	GAS MOIS.	GAS FLOW	EMISSION RATE	CONCENTRAT. GR/FT ³	DRY FACTOR
FPS	°F	%	DSCFH	LB/HR	GR/FT ³	LB/ TRUCK BODIES PER HOUR
46.1	321.4	3.07	5557.38	7.500E-04	1.581E-04	
MPS	°C	%	DSCMH	GM/SEC	GM/CM ³	GM/ TRUCK BODIES PER HOUR
14.0	160.8	3.07	157.58	4.47E-04	3.17E-04	

EMISSION COMPONENT: PARTICULATES

(IMPROVING EMISSIONS)

EMISSION RATE	CONCENTRAT. GR/FT ³	DRY FACTOR
LB/HR	GR/FT ³	LB/ TRUCK BODIES PER HOUR
7.500E-04	1.581E-04	
GM/SEC	GM/CM ³	GM/ TRUCK BODIES PER HOUR
4.47E-04	3.17E-04	

COMPONENT DISTRIBUTION IN SAMPLING POINT

POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PARTICULATES (MG)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
% OF TOTAL EMT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

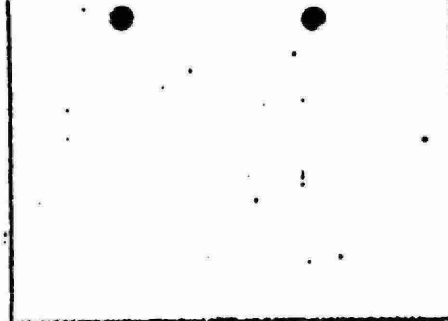
ISOKINETIC

AVERAGE ISOKINETICS	SAMPLING MIN.	DRY FACTOR
101.32	64.00	1.00

READINGS	SUB. ISO	SUPPLY	W. F. ISO	SMITHIN ISO	ACCEPTED FACT
16	0			16	
		100			
		16		16	

Operator G.M. - 3 Stac ACK
 Date NOV 15 - 77
 Run No. ALOE 1
 Sample Box No. _____
 Control Module No. GLT
 Meter (ΔH) _____
 C Factor .812

Schematic of



Cross Section

Assume Moisture (%). 2.5
 Heater Box Setting (°F). 250
 Probe Length (in.). 1/4
 Nozzle Diameter (in.). _____
 Nozzle Area (Sq. in.). _____
 STATIC PRESSURE 01
 B.P. - 29.42 (°Hg)

$V_{ac} < 2''/4s$

Reverse Point Number	Sampling Time (θ) Min.	Stack Temp. Ts (°F)	Velocity Head (ΔPs)	Velocity (Ft./sec)	Orifice Pressure Diff. (ΔH) in. H ₂ O	Gas Sample Volume (Vm) Cu. Ft.	Gas Temperature At Dry Gas Meter		Sample Box Temp. °F	Probe Temp. (°F)
							Inlet (Tm in.) °F	Outlet (Tm out) °F		
1-A	0	326	.56		1.43	73.286	51	52	260/72	253
	4	334	.54		2.0	75.515	52	52		
2-A	8	332	.48		1.4	78.790	54	53		
2-A	12	323	.48		1.3	81.478	56	54		
3-A	16	323	.46		1.45	83.295	57	55		
	20	320	.45		1.45	86.232	58	58		
4-A	24	319	.44		1.20	88.52	59	60		
	28	313	.44		1.15	90.76	61	60		
	32	—	—		—	93.167	—	—		
1-B	0	317	.46		1.2	93.167	58	63		
	4	315	.46		1.2	95.57	58	60		
2-B	8	315	.53		1.37	97.97	59	60		
	12	318	.54		1.60	100.50	60	61		
3-B	16	321	.49		1.50	103.16	60	62		
	20	316	.49		1.30	105.75	61	63		
4-B	24	316 312	.46		1.35	108.165	62	64		
	28	312	.46		1.35	110.60	61	65		
	32					113.015				

FIELD SAMPLING DATA SHEET CHART

PLANT CIN-TrackLOCATION Spec 03 (Aluminum K20)TEST Aldehyde #1DATE Nov 16/77OPERATORS C. W. + J. M.

ANALYST _____

MOISTURE DATA

Total 302.

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF MOISTURE (gm.)
IMPINGER # 1	(655.7) <u>1.50</u>	150 ml	
IMPINGER # 2	(646.0)	150 ml	
IMPINGER # 3	(504.7)	0	
IMPINGER # 4 <u>#41</u>	<u>661.7</u>	<u>658.9</u>	<u>2.80</u>
TOTAL			
MOISTURE VOLUME			ml.

14.710 in 585 ml

PARTICULATE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF PARTICULATE (gm.)
✓ FILTER <u>#8</u>	<u>.4052</u>	<u>#8 0.4002</u>	<u>0.005</u>
BEAKER WITH (PROBE - NOZZLE - CYCLONE) WASHINGS			
CYCLONE FLASK	—	—	—
BEAKER WITH (IMPINGER FILTER-HOLDER) CONTENTS AND WASHINGS			
TOTAL (gm.)			
PARTICULATES IN (mg.)			<u>5.00</u>

COMPANY: GENERAL MOTORS
 CITY: LANSING
 LOCATION: ELPO RD STACY
 TEST DATE: TEST #1, NOV. 15, 77

NUMBER OF TRAVERSES: 2.00

PT	DH H2O	DP H2O	TS °F	THI °F	TMO °F	TAVG °F	VM FT3	MM:LEAD-CH. OR TR.END	DGMV FT3	TIME MIN
1	1.43	0.560	326.00	51.0	52.0	51.5	73.29	0.00	2.30	4.0
2	2.00	0.540	332.00	52.0	52.0	52.0	75.59	0.00	3.21	4.0
3	1.40	0.480	332.00	54.0	53.0	53.5	78.79	0.00	2.69	4.0
4	1.30	0.480	323.00	56.0	54.0	55.0	81.48	0.00	1.77	4.0
5	1.15	0.460	323.00	57.0	55.0	56.0	83.35	0.00	2.99	4.0
6	1.45	0.450	320.00	58.0	58.0	58.0	86.24	0.00	2.28	4.0
7	1.20	0.440	319.00	59.0	60.0	59.5	88.52	0.00	2.24	4.0
8	1.15	0.440	313.00	61.0	60.0	60.5	90.76	0.00	2.41	4.0
9	1.20	0.460	317.00	58.0	63.0	60.5	93.17	93.17	2.40	4.0
10	1.20	0.460	315.00	58.0	60.0	59.0	95.57	0.00	2.40	4.0
11	1.37	0.530	315.00	59.0	60.0	59.5	97.97	0.00	2.53	4.0
12	1.60	0.540	318.00	60.0	61.0	60.5	100.50	0.00	2.66	4.0
13	1.50	0.490	321.00	60.0	62.0	61.0	103.16	0.00	2.59	4.0
14	1.30	0.490	316.00	61.0	63.0	62.0	105.75	0.00	2.42	4.0
15	1.35	0.460	312.00	62.0	64.0	63.0	108.17	0.00	2.44	4.0
16	1.35	0.460	312.00	61.0	65.0	63.0	110.60	0.00	2.42	4.0
							113.02			

AVER. 1.37 0.48 319.63 57.9 58.9 58.4 2.48

STACK GAS PRESSURE : FBAR= 29.42 IN HG
 P STAT= 0.01 IN HG, 0.14 IN H2O
 P STACK= 29.43 IN HG

STACK GAS MOISTURE: 2.03 WATER VOLUME IN IMPINGERS= 14.70 ML
 WATER VOLUME IN SILICA GEL= 3.80 ML
 MOISTURE VOLUME (TRAIN)= 0.83 SCF
 MOISTURE FRACTION, BWD = 0.02

SATURATION MOISTURE: 616.90
 RELATIVE HUMIDITY: 0.33
 SAMPLING TIME: 64.00
 SAMPLE VOLUME : 40.08

STACK GAS COMPOSITION %CO2= 0.00 %O2= 21.00 %CO= 0.00
 %N2= 79.00 %SO2= 0.00

STACK GAS MOLECULAR WEIGHT: DRY MW-MD 28.84
 WET MW-MW= 28.62
 %EXC. AIR=-145% 1.33

TRAIN COMPONENTS SPECS: PITOT COEFFICIENT CV= 0.8120
 NOZZLE DIAMETER = 0.2500 INCHES
 METER CORR. FACTOR = 1.0000

STACK DIMENSIONS: DIAMETER= 24.000 INCHES 0.000 INCHES
 AREA = 3.141 SQFT

PRODUCTION RATE : 4.00 TRUCK BODIES/MI

% ISOKINETIC

POINT	DH H2O	DP H2O	TS °F	VS FT/SEC	DGMV FT3	DGMO FT3/MIN	%I
1	1.43	0.56	326.0	51.1	2.30	0.57	98.24
2	2.00	0.54	332.0	49.4	3.21	0.80	125.80
3	1.40	0.48	332.0	46.5	2.69	0.67	111.48
4	1.30	0.48	323.0	46.3	1.77	0.44	72.64
5	1.15	0.46	323.0	45.3	2.99	0.75	125.35
6	1.45	0.45	320.0	44.7	2.28	0.57	96.18
7	1.20	0.44	319.0	44.2	2.24	0.56	95.08
8	1.15	0.44	313.0	44.0	2.41	0.60	101.56
9	1.20	0.46	317.0	45.1	2.40	0.60	99.43
10	1.20	0.46	315.0	45.1	2.40	0.60	99.47
11	1.37	0.53	315.0	43.4	2.53	0.63	97.63
12	1.60	0.54	318.0	43.9	2.66	0.67	101.75
13	1.50	0.49	321.0	43.7	2.59	0.65	104.08
14	1.30	0.49	316.0	43.6	2.42	0.60	96.50
15	1.35	0.46	312.0	45.0	2.44	0.61	99.99
16	1.35	0.46	312.0	45.0	2.42	0.60	99.17

PRODUCTION RATE : 4.00 TRUCK BODIES/HI

2. ISOKINETIC

POINT	DH H2O	DP H2O	TS °F	WS FT/SEC	DOHW FT2	DOHW FT3/MIN	Q
1	1.43	0.56	326.0	43.1	3.30	0.57	88.29
2	2.00	0.54	322.0	43.4	3.21	0.80	125.80
3	1.40	0.48	322.0	46.0	3.63	0.67	111.48
4	1.30	0.48	323.0	46.3	1.77	0.44	72.64
5	1.15	0.46	323.0	45.3	2.99	0.75	125.29
6	1.45	0.45	320.0	44.7	2.28	0.57	86.18
7	1.20	0.44	319.0	44.2	2.24	0.66	95.68
8	1.10	0.44	318.0	44.0	2.41	0.66	101.56
9	1.20	0.46	317.0	45.1	2.40	0.60	99.43
10	1.20	0.46	315.0	45.1	2.40	0.60	99.47
11	1.37	0.53	315.0	43.4	2.53	0.63	97.63
12	1.50	0.54	315.0	43.9	2.61	0.67	101.75
13	1.50	0.49	321.0	43.7	0.59	0.65	104.08
14	1.30	0.49	316.0	44.0	2.40	0.60	96.51
15	1.35	0.46	312.0	45.0	2.44	0.61	99.99
16	1.35	0.40	312.0	45.0	2.40	0.60	99.17

SUMMARY OF EMISSION TESTS

COMPANY: GENERAL MOTORS
LOCATION: ELPO #3 STACK
CITY: OSHANA

TEST & DATE: TEST #1, NOV. 15 77
TDA REPORT#: -
DATE REPORT REC'D:
CONSULTANT REPORT #:

EMISSION COMPONENT: PARTICULATES (INFRINGER EXCLUDED)

GAS VELOCITY	GAS TEMP.	GAS MOIS.	GAS FLOW	EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
FPS	°F	%	DSCFM	LB/HR	GR/FT3	LB/TRUCK BODY'S
46.3	319.6	2.03	5721.57	9.444E-02	1.926E-03	2.361E-02
MPS	°C	%	DSCMH	GM/SEC	GM/M3	KG/TRUCK BODIES
14.1	159.8	2.03	161.98	1.190E-02	4.406E-03	1.071E-02

EMISSION COMPONENT: PARTICULATES (INFRINGERS INCLUDED)

EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
LB/HR	GR/FT3	LB/TRUCK BODIES
9.444E-02	1.926E-03	2.361E-02
GM/SEC	GM/M3	KG/TRUCK BODIES
1.190E-02	4.406E-03	1.071E-02

COMPONENT DISTRIBUTION IN SAMPLING TRAIN

	PROBE	CYCLONE	FILTER	INFRINGERS	TOTAL
PARTICULATES (MG)	0.0000	0.0000	5.0000	0.0000	5.0000
% OF TOTAL PART	0.0000	0.0000	100.0000	0.0000	100.0000

ISOKINETIC & SAMPLING DATA SUMMARY

	AVERAGE ISOKINETICS 100.91	SAMPLING MIN. 64.00	SAMPLE VOLUME (SCM) 1.13
READINGS	SUB. ISO	SUPER ISO	NON. ISO
1	2	3	5
		190	NONISO
		13	3
			81
			21
			113
			115
			116
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			118
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			197
			198
			199
			200

Operator T. J. ...
 Date Nov 10/77
 Run No. AC-10
 Sample Box No. RAC
 Control Module No. ...
 Meter (AN) ...
 C Factor 51

Schematic of S...

12 pt/minute
 2' diameter
 stack

Cross Section

Assumed Moisture (%). ...
 Heater Box Setting (°F). 300
 Probe Length (in.). 6'
 Nozzle Diameter (in.). 25
 Nozzle Area (Sq. in.). ...
 STATIC PRESSURE 51

Inversion Point Number	Sampling Time (0) Min.	Stack Temp. Ts (°F)	Velocity Head (ΔPs)	Velocity (Ft./sec)	Orifice Pressure Diff. (ΔH) in. H ₂ O	Sample Volume (Vm) Cu. Ft.	Gas Temperature At Dry Gas Meter		Sample Box Temp. °F	Probe Temp. (°F)
							Inlet in. °F	Outlet (Tm out) °F		
1-A	0	326	.44		1.41	164.760	62	60	300/50	300
	3	326	.58		1.89	166.920	64	60		
	6	322	.63		2.06	169.180	70	60		
	9	322	.61		2.0	171.21	73	61	280/54	
	12	322	.60		1.83	173.33	76	63		
	15	322	.57		1.82	175.39	77	63		
	18	321	.48		1.80	177.40	80	64		
	21	320	.46		1.53	179.34	80	65		
	24	313	.47		1.56	181.23	80	66		
	27	305	.45		1.508	183.075	80	66		
	30	298	.41		1.40	184.90	80	68		
	33	296	.25		.85	186.67	82	67		
	36					188.227				
1-B	0	320	.38		1.25	188.227	67	66	280/54	
	3	320	.50		1.65	190.60	70	67		
	6	320	.515		1.80	191.90	68	76		
	9	320	.53		1.75	193.850	78	69		
	12	318	.575		1.93	195.875	78	69		

FIELD SAMPLING DATA SHEET CHART

SAMPLE # GM-03-CA-001

PLANT GM-ELPO

DATE Nov 10/77

LOCATION Stack #3 ACK

OPERATORS _____

TEST Acid

ANALYST _____

MOISTURE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF MOISTURE (gm.)
IMPINGER # 1	169.0	150.0 nd	19
IMPINGER # 2	169.0	150.0 nd	19
IMPINGER # 3	2.5	0	2.5
IMPINGER # 4	688.8	677.9	10.9
TOTAL			
MOISTURE VOLUME			51.4 ml.

40.5

POLICA-
EL
FILLED

PARTICULATE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF PARTICULATE (gm.)
✓ FILTER # 7	0.4124	4070	0.0054
BEAKER WITH (PROBE - NOZZLE - CYCLONE) WASHINGS			
CYCLONE FLASK			
BEAKER WITH (IMPINGER FILTER-HOLDER) CONTENTS AND WASHINGS			
TOTAL (gm.)			-
PARTICULATES IN (mg.)			- 5.40

TEST OF GENERAL METHOD
 DATE: 10-10-77
 LOCATION: ELFO NO. 3 STAGE
 TEST DATE: TEST 10-10-77

NUMBER OF TRAVERSES: 2.00

PT	DH H2O	DP H2O	TS °F	TH1 °F	TH0 °F	THFG °F	VH FTS	VH/LEAK-CH. OR TR.END	DGMV FTS	TIME MIN
1	1.41	0.440	326.00	62.0	60.0	61.0	164.76	0.00	2.16	3.0
2	1.89	0.580	326.00	66.0	60.0	63.0	166.92	0.00	2.18	3.0
3	2.06	0.630	322.00	70.0	60.0	65.0	169.10	0.00	2.11	3.0
4	2.00	0.610	322.00	73.0	61.0	67.0	171.21	0.00	2.12	3.0
5	1.93	0.600	322.00	76.0	63.0	69.5	173.33	0.00	2.06	3.0
6	1.88	0.570	322.00	77.0	63.0	70.0	175.39	0.00	2.01	3.0
7	1.80	0.480	321.00	80.0	64.0	72.0	177.40	0.00	1.94	3.0
8	1.53	0.460	320.00	80.0	65.0	72.5	179.34	0.00	1.89	3.0
9	1.56	0.470	313.00	80.0	66.0	73.0	181.23	0.00	1.85	3.0
10	1.50	0.450	305.00	80.0	66.0	73.0	183.08	0.00	1.83	3.0
11	1.40	0.410	298.00	80.0	68.0	74.0	184.90	0.00	1.77	3.0
12	0.85	0.250	296.00	82.0	67.0	74.5	186.67	0.00	1.56	3.0
13	1.25	0.380	320.00	67.0	66.0	66.5	188.33	188.33	1.77	3.0
14	1.65	0.500	320.00	70.0	67.0	68.5	190.00	0.00	1.90	3.0
15	1.80	0.515	320.00	68.0	76.0	72.0	191.90	0.00	1.95	3.0
16	1.75	0.530	320.00	78.0	69.0	73.5	193.85	0.00	2.03	3.0
17	1.93	0.575	320.00	78.0	69.0	73.5	195.88	0.00	2.09	3.0
18	1.80	0.590	322.00	78.0	68.0	73.0	197.90	0.00	2.10	3.0
19	1.85	0.560	320.00	76.0	67.0	71.5	200.06	0.00	2.01	3.0
20	1.75	0.530	318.00	74.0	66.0	70.0	202.07	0.00	1.95	3.0
21	1.65	0.500	314.00	74.0	64.0	69.0	204.02	0.00	1.91	3.0
22	1.40	0.410	305.00	74.0	64.0	69.0	205.93	0.00	1.80	3.0
23	0.75	0.250	298.00	74.0	65.0	69.5	207.70	0.00	1.47	3.0
24	0.24	0.100	296.00	71.0	64.0	67.5	209.20	0.00	1.00	3.0
							210.20			

AVER. 1.56 0.47 315.25 74.5 65.3 69.9 1.89

STACK GAS PRESSURE : PBAR= 29.12 IN HG
 P STAT= 0.01 IN HG 0.14 IN H2O
 P STACK= 29.13 IN HG

STACK GAS MOISTURE: 5.20 WATER VOLUME IN IMPINGERS= 40.50 ML
 WATER VOLUME IN SILICA GEL= 10.90 ML
 MOISTURE VOLUME (TRAIN)= 2.44 SCF
 MOISTURE FRACTION, BND = 0.05

SATURATION MOISTURE: 585.53
 RELATIVE HUMIDITY: 0.89
 SAMPLING TIME: 72.00
 SAMPLE VOLUME : 44.40

STACK GAS COMPOSITION %CO2= 0.00 %O2= 21.00 %CO= 0.00
 %N2= 79.00 %SO2= 0.00

STACK GAS MOLECULAR WEIGHT: DRY MW-MD 28.84
 NET MW-MW= 28.28
 %EXC. AIR=-14583.33

TRAIN COMPONENTS SPECS: PITOT COEFFICIENT CVP= 0.9100
 NOZZLE DIAMETER = 0.2500 INCHES
 METER CORR. FACTOR = 1.0000

STACK DIMENSIONS: DIAMETER= 24.000 INCHES 0.000 INCHES
 AREA = 3.142 SQFT

PRODUCTION RATE : 4.00 TRUCK BODIES/MI

% ISOKINETIC

POINT	DH H2O	DP H2O	TS °F	VS FT/SEC	DGMV FTS	DGMO FTS/MIN	%I
1	1.41	0.44	326.0	44.8	2.16	0.72	125.51
2	1.89	0.58	326.0	51.4	2.18	0.73	110.04
3	2.06	0.63	322.0	53.5	2.11	0.70	101.59
4	2.00	0.61	322.0	52.6	2.12	0.71	103.32
5	1.93	0.60	322.0	52.2	2.06	0.69	100.71
6	1.88	0.57	322.0	50.9	2.01	0.67	100.73
7	1.80	0.48	321.0	48.6	1.94	0.65	100.16
8	1.53	0.46	320.0	45.6	1.89	0.63	104.72
9	1.56	0.47	313.0	45.9	1.85	0.62	100.59
10	1.50	0.45	305.0	44.7	1.83	0.61	101.14
11	1.40	0.41	298.0	42.5	1.77	0.59	102.08
12	0.85	0.25	296.0	33.1	1.56	0.52	114.57

1	1.41	0.44	326.0	44.8	2.16	0.72	100.51
2	1.89	0.58	326.0	51.4	2.18	0.73	110.04
3	2.06	0.63	322.0	53.5	2.11	0.70	101.53
4	2.00	0.61	322.0	52.6	2.12	0.71	103.32
5	1.80	0.60	322.0	50.2	2.00	0.67	100.71
6	1.80	0.57	322.0	46.9	1.90	0.65	100.00
7	1.80	0.48	321.0	46.6	1.80	0.63	100.42
8	1.53	0.46	320.0	45.6	1.80	0.63	104.72
9	1.56	0.47	313.0	45.9	1.85	0.62	100.59
10	1.50	0.45	305.0	44.7	1.83	0.61	101.14
11	1.40	0.41	298.0	42.5	1.77	0.59	102.08
12	0.85	0.25	296.0	33.1	1.56	0.52	114.57
13	1.25	0.38	320.0	41.5	1.77	0.59	109.23
14	1.65	0.50	320.0	47.6	1.90	0.63	101.77
15	1.80	0.52	320.0	48.3	1.95	0.65	102.27
16	1.75	0.52	320.0	49.0	2.03	0.68	104.39
17	1.93	0.58	320.0	51.0	2.09	0.70	103.23
18	1.80	0.59	322.0	51.7	2.10	0.70	102.84
19	1.85	0.56	320.0	50.3	2.01	0.67	101.20
20	1.75	0.53	318.0	48.8	1.95	0.65	101.05
21	1.65	0.50	314.0	47.4	1.91	0.64	101.81
22	1.40	0.41	305.0	42.7	1.80	0.60	105.04
23	0.75	0.25	298.0	33.2	1.47	0.49	100.00
24	0.24	0.10	296.0	20.9	1.00	0.33	100.00

SUMMARY OF EMISSION TESTS

COMPANY: GENERAL MOTORS
LOCATION: ELPO #3 STACK
CITY: OSHANA

TEST & DATE: TEST #2-DOW, 10-77
TDR REPORT#: -
DATE REPORT REC'D:
CONSULTANT REPORT #:

EMISSION COMPONENT: PARTICULATES

(IMPRINGER EXCLUDED)

GAS VELOCITY	GAS TEMP.	GAS MOIS.	GAS FLOW	EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
FPS	°F	%	DSCFM	LB/HR	GR/FT3	LB/TRUCK BODIES
45.7	315.3	5.20	5431.49	8.739E-02	1.877E-03	2.185E-02
MPS	°C	%	DSCMH	GM/SEC	GM/M3	KG/TRUCK BODIES
13.9	157.4	5.20	153.77	1.101E-02	4.295E-03	9.910E-03

EMISSION COMPONENT: PARTICULATES

(IMPRINGERS INCLUDED)

EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
LB/HR	GR/FT3	LB/TRUCK BODIES
8.739E-02	1.877E-03	2.185E-02
GM/SEC	GM/M3	KG/TRUCK BODIES
1.101E-02	4.295E-03	9.910E-03

COMPONENT DISTRIBUTION IN SAMPLING TRAIN

	PROBE	CYCLONE	FILTER	IMPRINGERS	TOTAL
PARTICULATES (MG)	0.0000	0.0000	5.4000	0.0000	5.4000
% OF TOTAL PART	0.0000	0.0000	100.0000	0.0000	100.0000

ISOKINETIC & SAMPLING DATA SUMMARY

AVERAGE ISOKINETICS		SAMPLING MIN.		SAMPLE VOLUME SCM	
105.42		72.00		1.29	
READINGS	SUB.ISO	SUPERISO	NON.ISO	WITHIN ISO	ACCEPTABILITY FACTOR
24	0	4	4	33	95.1% (100% WELL WITHIN)
		ISO	NONISO		
		22	2	92	95.1% (100% WELL WITHIN)
		2	1		

FIELD SAMPLING DATA SHEET CHART

Operator J. M. J.
 Date Nov 17/77
 Run No. ACID #1
 Sample Box No. RAC
 Control Module No. ...
 Meter (ΔP) ...
 C Factor ...

Schematic of S

Cross Section

Assumed Moisture (%) 2.5
 Heater Box Setting ($^{\circ}\text{F}$) 25
 Probe Length (in.) 6'
 Nozzle Diameter (in.) .25
 Nozzle Area (Sq. in.) 0.1
 STATIC PRESSURE 0.1 H₂O

 $V \leftarrow 2.5 \text{ " Hg}$

Inversion Point Number	Sampling Time (H) Min.	Stack Temp. T_s ($^{\circ}\text{F}$)	Velocity Head (ΔP_s)	Velocity (Ft./sec)	Orifice Pressure Diff. (ΔH) in. H ₂ O	Gas Sample Volume (Vm) Cu. Ft.	Gas Temperature At Dry Gas Meter		Sample Box Temp. T_b ($^{\circ}\text{F}$)	Probe Temp. ($^{\circ}\text{F}$)
							Inlet (T_m in.) $^{\circ}\text{F}$	Outlet (T_m out) $^{\circ}\text{F}$		
1-A	0	348	.53		1.60	250.006	50	50	250/54	
	4	348	.53		1.60	252.500	54	50		
2-A	8	350	.49		1.2	255.02	59	51		
	12	350	.49		1.3	257.352	61	52		
3-A	16	348	.45		1.2	259.738	62	52		
	20	346	.45		1.3	262.090	63	52		
4-A	24	340	.40		1.2	264.515	63	53		
	28	340	.37		1.1	266.90	66	54		
	32					269.108				
1-B	0	338	.43		1.2	269.108	60	55	250/56	
	4	343	.43		1.1	271.586	63	58		
2-B	8	343	.46		1.2	273.732	65	56		
	12	341	.46		1.2	276.095	70	58		
3-B	16	342	.50		1.3	278.476	70	60		
	20	342	.50		1.4	280.938	72	62		
4-B	24	340	.38		1.0	283.418	73	62		
	28	332	.34		1.0	285.656	73	61		
	32					287.90				

PLANT EM, CRPODATE 17/11/77LOCATION Stable #02 Grover (N.P.)

OPERATORS _____

TEST Acid #1

ANALYST _____

MOISTURE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF MOISTURE (gm.)
IMPINGER # 1	662.5	649.9	12.6
IMPINGER # 2	693.5	684.1	9.4
IMPINGER # 3	510.8	509.8	1.0
IMPINGER # 4	725.1	717.0	8.1
TOTAL			31.10
MOISTURE VOLUME			ml.

23.0

PARTICULATE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF PARTICULATE (gm.)
✓ FILTER (15)	4027	3977	0.0050
BEAKER WITH (PROBE - NOZZLE - CYCLONE) WASHINGS			
CYCLONE FLASK	—	—	—
BEAKER WITH (IMPINGER FILTER-HOLDER) CONTENTS AND WASHINGS			
TOTAL (gm.)			
PARTICULATES IN (mg.)			5.00

Washing

Impinger

32.2

80
55
142

COMPRESSOR GENERAL NOTES
 CITY: OSHANA
 LOCATION: FIELD #1 (0.0) (GP)
 TEST DATE: TEST #2-0007.17-77.

NUMBER OF TRAVERSES: 2.00

PT	DH H2O	DP H2O	TS °F	TMI °F	TMO °F	TAVG °F	VA FT3	VA/LEAK-CH. OF TR.END	DGMV FT3	TIME MIN
1	1.60	0.500	348.00	50.0	50.0	50.0	250.00	0.00	2.50	4.0
2	1.60	0.530	348.00	54.0	50.0	52.0	252.50	0.00	2.52	4.0
3	1.20	0.490	350.00	59.0	51.0	55.0	255.00	0.00	2.33	4.0
4	1.30	0.490	350.00	61.0	52.0	56.5	257.35	0.00	2.39	4.0
5	1.20	0.450	348.00	62.0	52.0	57.0	259.74	0.00	2.35	4.0
6	1.30	0.450	346.00	63.0	52.0	57.5	262.09	0.00	2.43	4.0
7	1.20	0.400	346.00	63.0	53.0	58.0	264.52	0.00	2.39	4.0
8	1.10	0.370	348.00	65.0	54.0	60.0	266.90	0.00	2.21	4.0
9	1.20	0.430	338.00	60.0	55.0	57.5	269.11	269.11	2.48	4.0
10	1.10	0.430	343.00	63.0	56.0	59.5	271.59	0.00	2.15	4.0
11	1.20	0.460	343.00	65.0	56.0	60.5	273.73	0.00	2.36	4.0
12	1.20	0.460	341.00	70.0	58.0	64.0	276.10	0.00	2.38	4.0
13	1.30	0.500	342.00	70.0	60.0	65.0	278.48	0.00	2.46	4.0
14	1.40	0.500	342.00	72.0	62.0	67.0	280.94	0.00	2.48	4.0
15	1.00	0.370	340.00	73.0	62.0	67.5	283.42	0.00	2.24	4.0
16	1.00	0.340	332.00	73.0	61.0	67.0	285.66	0.00	2.24	4.0
							287.90			

AVG. 1.24 0.45 343.19 64.0 55.3 59.6 2.37

STACK GAS PRESSURE : PBAR= 29.12 IN HG
 P STAT= 0.01 IN HG, 0.14 IN H2O
 P STACK= 29.10 IN HG

STACK GAS MOISTURE: 3.76 WATER VOLUME IN IMPINGERS= 23.00 ML
 WATER VOLUME IN SILICA GEL= 8.10 ML
 MOISTURE VOLUME (TRAIN)= 1.47 SCF
 MOISTURE FRACTION-BWD = 0.04

SATURATION MOISTURE: 861.08

RELATIVE HUMIDITY: 0.44

SAMPLING TIME: 64.00

SAMPLE VOLUME : 37.74 SDC

STACK GAS COMPOSITION %CO2= 0.00 %O2= 21.00 %CO= 0.00
 %N2= 79.00 %SO2= 0.00

STACK GAS MOLECULAR WEIGHT: DRY MW-MD 28.84
 NET MW-MW= 28.43
 %ENC. AIR=-14583.33

TRAIN COMPONENTS SPECS: PITOT COEFFICIENT CV= 0.8100
 NOZZLE DIAMETER = 0.2500 INCHES
 METER CORR. FACTOR = 1.0000

STACK DIMENSIONS: DIAMETER= 24.000 INCHES 0.000 INCHES
 AREA = 3.142 SQFT

PRODUCTION RATE : 4.00 TRUCK BODIES/MI

% ISOTHERMIC

POINT	DH H2O	DP H2O	TS °F	VS FT/SEC	DGMV FT3	DGMV FT3/MIN	%I
1	1.60	0.50	348.0	45.7	2.50	0.63	101.60
2	1.60	0.53	348.0	49.7	2.52	0.63	102.02
3	1.20	0.49	350.0	47.8	2.33	0.58	97.63
4	1.30	0.49	350.0	47.8	2.39	0.60	99.53
5	1.20	0.45	348.0	45.8	2.35	0.59	102.23
6	1.30	0.45	346.0	45.7	2.43	0.61	105.20
7	1.20	0.40	340.0	43.0	2.39	0.60	109.20
8	1.10	0.37	340.0	41.0	2.21	0.55	101.00
9	1.20	0.43	338.0	44.5	2.48	0.62	109.40
10	1.10	0.43	343.0	44.6	2.15	0.54	94.64
11	1.20	0.46	343.0	46.3	2.36	0.59	100.59
12	1.20	0.46	341.0	46.1	2.38	0.60	100.56
13	1.30	0.50	342.0	48.1	2.46	0.62	99.63
14	1.40	0.50	342.0	48.1	2.48	0.62	100.00
15	1.00	0.37	340.0	41.3	2.24	0.56	104.57
16	1.00	0.34	332.0	39.4	2.24	0.56	106.93

PRODUCTION RATE : 4.00 TRUCK BODIES MI

% ISO KINETIC

POINT	DH H2O	DP H2O	TS °F	VS FT/SEC	DGMV °T3	DGMH FT3/MIN	EF
1	1.60	0.53	348.0	49.7	2.50	0.63	101.60
2	1.60	0.53	348.0	49.7	2.50	0.63	102.02
3	1.20	0.49	350.0	47.8	2.31	0.58	97.63
4	1.30	0.49	350.0	47.8	2.39	0.60	98.63
5	1.20	0.45	348.0	45.9	2.25	0.55	103.33
6	1.30	0.45	348.0	45.7	2.41	0.61	105.23
7	1.20	0.40	346.0	43.8	2.34	0.60	109.20
8	1.10	0.37	340.0	41.7	2.15	0.55	114.77
9	1.20	0.43	350.0	44.5	2.44	0.62	107.40
10	1.10	0.43	343.0	44.6	2.15	0.54	94.64
11	1.20	0.46	343.0	46.2	2.30	0.59	100.59
12	1.20	0.46	341.0	46.1	2.32	0.60	100.50
13	1.30	0.50	343.0	48.1	2.46	0.62	99.63
14	1.40	0.50	343.0	48.1	2.43	0.62	100.00
15	1.00	0.37	340.0	41.8	2.11	0.56	104.57
16	1.00	0.34	337.0	39.4	2.24	0.56	103.93

SUMMARY OF EMISSION TEST:

COMPANY: GENERAL MOTORS
LOCATION: ELPO #2 STACK (GR)
CITY: OSHAWA

TEST #, DATE: TEST #2, 04.17.77,
TDA REPORT#: -
DATE REPORT REC'D:
CONSULTANT REPORT #:

EMISSION COMPONENT: PARTICULATES,

(IMPRINGER EXCLUDED)

GAS VELOCITY	GAS TEMP.	GAS MOIS.	GAS FLOW	EMISSION RATE	CONCENTRAT. GR/FT3	EMISSION FACTOR
FPS	°F	%	DSCFM	LB/HR	GR/FT3	LB/TRUCK BODIES
45.6	343.2	3.76	5311.60	9.310E-02	2.045E-03	2.327E-02
MPS	°C	%	DSCMH	GM/SEC	GM/M3	KG/TRUCK BODIES
13.9	173.9	3.76	150.37	1.173E-02	4.679E-03	1.056E-02

EMISSION COMPONENT: PARTICULATES,

(IMPRINGERS INCLUDED)

EMISSION RATE	CONCENTRAT. GR/FT3	EMISSION FACTOR
LB/HR	GR/FT3	LB/TRUCK BODIES
9.310E-02	2.045E-03	2.327E-02
GM/SEC	GM/M3	KG/TRUCK BODIES
1.173E-02	4.679E-03	1.056E-02

COMPONENT DISTRIBUTION IN SAMPLING TRAIN

	PROBE	CYCLONE	FILTER	IMPRINGERS	TOTAL
PARTICULATES, (MG)	0.0000	0.0000	5.0000	0.0000	5.0000
% OF TOTAL PART	0.0000	0.0000	100.0000	0.0000	100.0000

ISO KINETIC & SAMPLING DATA SUMMARY

AVERAGE %ISO KINETICS 102.53		SAMPLING MIN. 64.00		SAMPLE VOLUME (SCMH) 1.07 -	
READINGS	SUB. ISO	SUPER ISO	NON. ISO	WITHIN ISO	ACCEPTABILITY FACTOR
16	0	0	0	100	95 ISO:110 WELL TYPED
		130 12	NON ISO 0	100	85 ISO:110 WELL TYPED

Operator S. Mc
 Date Nov 17/77
 Run No. ALDE # 1
 Sample Box No. CTI
 Control Module No.
 Meter (ΔH)
 Factor

Schematic of

Cross Section
 Assumed Moisture (%) 2.5
 Heater Box Setting (°F) 300
 Probe Length (in.) 6'
 Nozzle Diameter (in.) .25
 Nozzle Area (Sq. in.)
 STATIC PRESSURE 401" Hg

Vacuum 2.5" Hg

FIELD SAMPLING DATA SHEET CHART

Traverse Point Number	Sampling Time (θ) Min.	Stack Temp. Ts (°F)	Velocity Head (ΔPs)	Velocity (Ft./sec)	Orifice Pressure Diff. (ΔH) in. H ₂ O	Gas Sample Volume (Vm) Cu. Ft.	Gas Temperature At Dry Gas Meter		Sample Box Temp. of	Probe Temp. (°F)
							Inlet (Tm in.) of	Outlet (Tm out) of		
1-A	0	350	.45		1.15	150.835	48	48	12/250	325
	4	350	.45		1.30	152.995	48	48		
2-A	8	348	.42		1.05	155.30	49	50		
	12	349	.42		1.10	157.480	51	51		
3-A	16	356	.41		1.15	159.669	55	52		
	20	356	.41		1.20	161.905	56	56		
4-A	24	352	.38		1.0	164.148	56	57		
	28	349	.38		1.1	166.305	59	58		
	32					168.517				
		349	.42							
1-B	0	349	.42		1.2	168.517	58	61		
	4	351	.42		1.1	170.938	59	61	46/317	337
2-B	8	350	.44		1.45	173.252	62	59		
3-B	12	351	.44		1.30	175.730	63	59		
3-B	16	350	.46		1.40	178.085	61	63		
	20	350	.46		1.40	180.482	62	67		
4-B	24	342	.42		1.1	182.893	59	66		
	28	343	.44		1.3	185.237	59	66		
	32					187.684				

PLANT GMLOCATION # 02 - Groover (N.P.)TEST Aldridge # 1DATE 17/11/77

OPERATORS _____

ANALYST _____

MOISTURE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF MOISTURE (gm.)
IMPINGER # 1	666.6	655.6	11.0
IMPINGER # 2	645.4	666.4	-21.0
IMPINGER # 3	538.0	509.7	28.3
IMPINGER # 4	699.6	692.6	7.0
TOTAL			25.30
MOISTURE VOLUME			ml.

PARTICULATE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF PARTICULATE (gm.)
✓ FILTER 16	0.4104	4052	0.0052
BEAKER WITH (PROBE - NOZZLE - CYCLONE) WASHINGS			
CYCLONE FLASK	—	—	—
BEAKER WITH (IMPINGER FILTER-HOLDER) CONTENTS AND WASHINGS			
TOTAL (gm.)			
PARTICULATES IN (mg.)			0.52

Imp. Wash

320

125
 + 60
 + 105
 10
 —
 290
 300

5.2

CODE: 1 - PULS. DETECTOR
 C17: 16
 1.000000 11.1 STAGE: GRY
 25310000 01.0001.17.77

NUMBER OF TRAVERSES: 2.00

PT	DH H2O	DP H2O	TS °F	TH1 °F	TH0 °F	TAVG °F	VS FTS	VS:LERI-CH. OF TR.END	DGMV FTS	TIME MIN
1	1.15	0.450	350.00	48.0	48.0	48.0	50.84	0.00	2.16	4.0
2	1.30	0.450	350.00	48.0	48.0	48.0	53.00	0.00	2.31	4.0
3	1.05	0.420	349.00	49.0	50.0	49.5	155.30	0.00	2.18	4.0
4	1.10	0.420	349.00	51.0	51.0	51.0	157.40	0.00	2.19	4.0
5	1.15	0.410	350.00	55.0	52.0	53.5	159.67	0.00	2.24	4.0
6	1.20	0.410	350.00	56.0	52.0	54.0	161.91	0.00	2.24	4.0
7	1.00	0.380	352.00	56.0	57.0	56.5	164.15	0.00	2.16	4.0
8	1.10	0.380	349.00	59.0	58.0	58.5	166.31	0.00	2.21	4.0
9	1.20	0.420	349.00	58.0	61.0	59.5	168.50	168.52	2.42	4.0
10	1.10	0.420	351.00	59.0	61.0	60.0	170.94	0.00	2.31	4.0
11	1.45	0.440	350.00	62.0	59.0	60.5	173.25	0.00	2.48	4.0
12	1.30	0.440	351.00	63.0	59.0	61.0	175.73	0.00	2.36	4.0
13	1.40	0.460	350.00	61.0	63.0	62.0	178.09	0.00	2.40	4.0
14	1.40	0.460	350.00	62.0	67.0	64.5	180.48	0.00	2.41	4.0
15	1.10	0.420	342.00	59.0	66.0	62.5	182.89	0.00	2.34	4.0
16	1.30	0.440	343.00	59.0	66.0	62.5	185.24	0.00	2.45	4.0
							187.68			

AVG. 1.21 0.43 349.75 56.6 57.6 57.1 2.30

STACK GAS PRESSURE : PBAR= 29.12 IN HG
 P STAT= 0.01 IN HG, 0.14 IN H2O
 P STACK= 29.3 IN HG

STACK GAS MOISTURE: 3.15 WATER VOLUME IN IMPINGERS= 18.30 ML
 WATER VOLUME IN SILICA GEL= 7.00 ML
 MOISTURE VOLUME (TRAIN)= 1.20 SCF
 MOISTURE FRACTION-BKG = 0.03

SATURATION MOISTURE: 100.00 %
 RELATIVE HUMIDITY: 3.15 %
 SAMPLING TIME : 64.00 MIN
 SAMPLING VOLUME : 36.87 SCF

STACK GAS COMPOSITION %CO2= 0.00 %O2= 21.00 %CO= 0.00
 %N2= 79.00 %SO2= 0.00

STACK GAS MOLECULAR WEIGHT: DRY MW-MD 28.84
 NET MW-MW= 28.50
 AENCO. AIR=14583.33

TRAIN COMPONENTS SPECS: PITOT COEFFICIENT CV= 0.8120
 NOZZLE DIAMETER = 0.2500 INCHES
 METER CORR. FACTOR = 1.0000

STACK DIMENSIONS: DIAMETER= 24.000 INCHES 0.000 INCHES
 AREA = 3.142 SQFT

PRODUCTION RATE : 4.00 TRUCK BODIES/MIN

% ISOKINETIC

POINT	DH H2O	DP H2O	TS °F	VS FT/SEC	DGMV FTS	DGM0 FTS/MIN	%
1	1.15	0.45	350.0	45.9	2.16	0.54	94.93
2	1.30	0.45	350.0	45.9	2.31	0.58	101.34
3	1.05	0.42	348.0	44.3	2.18	0.55	98.73
4	1.10	0.42	349.0	44.3	2.19	0.55	98.92
5	1.15	0.41	350.0	44.0	2.24	0.56	102.23
6	1.20	0.41	350.0	44.0	2.24	0.56	102.06
7	1.00	0.38	352.0	42.3	2.16	0.54	101.55
8	1.10	0.38	349.0	42.3	2.21	0.55	103.57
9	1.20	0.42	349.0	44.3	2.42	0.61	107.64
10	1.10	0.42	351.0	44.4	2.31	0.58	102.89
11	1.45	0.44	350.0	45.4	2.48	0.63	107.57
12	1.30	0.44	351.0	45.4	2.36	0.59	102.16
13	1.40	0.46	350.0	45.4	2.40	0.60	101.46
14	1.40	0.46	350.0	45.4	2.41	0.60	101.57
15	1.10	0.42	342.0	44.1	2.34	0.59	103.15
16	1.30	0.44	343.0	45.2	2.45	0.61	105.32

% ISOKINETIC

POINT	DP H2O	DP H2O	TS °F	VS FT/SEC	DCH FT3	DCH FT3/HR	LI
1	1.15	0.45	350.0	45.9	2.16	0.54	94.93
2	1.30	0.45	350.0	45.9	2.31	0.53	101.34
3	1.05	0.42	348.0	44.3	2.10	0.55	98.73
4	1.10	0.42	349.0	44.3	2.19	0.55	98.92
5	1.15	0.41	356.0	44.0	2.24	0.56	102.23
6	1.20	0.41	356.0	44.0	2.24	0.56	102.06
7	1.00	0.39	352.0	42.2	2.10	0.54	101.58
8	1.10	0.38	349.0	40.2	2.11	0.55	103.57
9	1.20	0.42	349.0	44.2	2.41	0.61	107.64
10	1.10	0.42	351.0	44.4	2.31	0.58	102.89
11	1.45	0.44	350.0	45.4	2.48	0.62	107.57
12	1.30	0.44	351.0	45.4	2.36	0.59	102.16
13	1.40	0.46	350.0	46.4	2.40	0.60	101.46
14	1.40	0.46	350.0	46.4	2.41	0.60	101.57
15	1.10	0.42	342.0	44.1	2.34	0.59	103.15
16	1.30	0.44	343.0	45.2	2.45	0.61	105.32

SUMMARY OF EMISSION TESTS

COMPANY: GENERAL MOTORS
LOCATION: ELPO JACK (GR)
CITY: OSHAWA

TEST & DATE: TEST #1-10/17/77
TDR REPORT#:
DATE REPORT REC'D:
CONSULTANT REPORT #:

EMISSION COMPONENT: PARTICULATES

(IMPINGER EXCLUDED)

GAS VELOCITY	GAS TEMP.	GAS MOIS.	GAS FLOW	EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
FPS	°F	%	DSCFM	LB/HR	GR/FT3	LB/TRUCK BODIES
44.7	349.8	3.15	5195.34	9.694E-02	2.177E-03	2.423E-02
MPS	°C	%	DSCMA	GM/SEC	GM/M3	KG/TRUCK BODIES
13.6	176.5	3.15	147.08	1.221E-02	4.981E-03	1.099E-02

EMISSION COMPONENT: PARTICULATES

(IMPINGERS INCLUDED)

EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
LB/HR	GR/FT3	LB/TRUCK BODIES
9.694E-02	2.177E-03	2.423E-02
GM/SEC	GM/M3	KG/TRUCK BODIES
1.221E-02	4.981E-03	1.099E-02

COMPONENT DISTRIBUTION IN SAMPLING TRAIN

	PROBE	CYCLONE	FILTER	IMPINGERS	TOTAL
PARTICULATES (MG)	0.0000	0.0000	5.0000	0.0000	5.0000
% OF TOTAL FART	0.0000	0.0000	100.0000	0.0000	100.0000

ISOKINETIC & SAMPLING DATA SUMMARY

READINGS	AVERAGE % ISOKINETICS 102.19	SAMPLING MIN. 64.00	SAMPLE VOLUME (SCM) 1.04	WITHIN ISO	ACCEPTILITY FACTOR
16	0	0	0	100	90 (10) 110 WELL WITHIN
	ISO 16	NONISO 0		100	85 (10) 115 WELL WITHIN

FIELD SAMPLING DATA SHEET CHART

Operator Mc
 Date Nov 15
 Run No. AC 10 # 1
 Sample Box No. RAC
 Control Module No.
 Meter (ΔH)
 C Factor 810

Schematic of S

Cross Section

Assumed Moisture (%). 2.5
 Heater Box Setting ($^{\circ}\text{F}$). 30
 Probe Length (in.). 6
 Nozzle Diameter (in.). 2
 Nozzle Area (Sq. in.).
 STATIC PRESSURE "Hg 20

In Reverse Point Number	Sampling Time (θ) Min.	Stack Temp. T_s ($^{\circ}\text{F}$)	Velocity Head (ΔP_s)	Velocity (Ft./sec)	Orifice Pressure Diff. (ΔH) in. H_2O	Gas Sample Volume (Vm) Cu. Ft.	Gas Temperature At Dry Gas Meter		Sample Box Temp. of	Free Temp ($^{\circ}\text{F}$)
							Inlet (T_m in.) $^{\circ}\text{F}$	Outlet (T_m out) $^{\circ}\text{F}$		
1-A	0	290	.5	X	1.675	211.105	50	50	240/50	300
	4	295	.47		1.46	213.605	58	50		
2-A	8	295	.40		1.40	216.048	58	50		
	12	292	.47		1.42	218.455	63	52		
3-A	16	288	.47		1.40	220.866	65	54		
	20	305	.48		1.60	223.287	68	54		
4-A	24	280	.40		1.38	225.732	70	55		
	28	276	.38		1.30	228.127	72	56		
	32	2				230.463				
1-B	0	300	.48		1.60	230.463	58	55	240/50	300
	4	300	.49		1.65	232.912	64	58		
2-B	8	300	.45		1.50	235.378	68	58		
	12	300	.44		1.50	237.820	70	60		
3-B	16	298	.45		1.50	239.660	72	60		
	20	300	.45		1.50	242.705	74	60		
4-B	24	288	.37		1.20	245.140	74	61		
	28	285	.38		1.20	247.435	74	62		
	32					249.677				

PLANT GMLOCATION HIPPIE TREAT Stock #01TEST ACID #1DATE 15/10/77

OPERATORS _____

ANALYST _____

MOISTURE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF MOISTURE (gm.)
IMPINGER # 1	744.	649.8	94.2
IMPINGER # 2	606.6	682.6	-76.0
IMPINGER # 3	509.7	507.7	2.0
IMPINGER # 4 <u>20</u>	717.0	707.6	9.4
TOTAL			29.6
MOISTURE VOLUME.			ml.

PARTICULATE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF PARTICULATE (gm.)
✓ FILTER (13)	0.4016	0.3980	0.0036
BEAKER WITH (PROBE - NOZZLE - CYCLONE) WASHINGS			
CYCLONE FLASK	—	—	—
BEAKER WITH (IMPINGER FILTER-HOLDER) CONTENTS AND WASHINGS			
TOTAL (gm.)			
PARTICULATES IN (mg.)			3.60

work

120
10
88235
78

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 MECHANICAL ENGINEERS
 1100 15th St., N.W., Washington, D.C. 20004

NUMBER OF TRAVERSES: 2.00

PT	DH H2O	DP H2O	TS °F	THI °F	TMO °F	TMO °F	VM FT3	VM:LEAK-CH. OR TR.END	DGMV FT3	TIME MIN
1	1.68	0.500	290.00	50.0	50.0	50.0	211.11	0.00	2.50	4.0
2	1.46	0.470	295.00	58.0	50.0	54.0	213.61	0.00	2.44	4.0
3	1.40	0.460	295.00	58.0	50.0	54.0	218.05	0.00	2.41	4.0
4	1.42	0.470	292.00	63.0	52.0	57.5	218.46	0.00	2.41	4.0
5	1.40	0.470	288.00	65.0	54.0	59.5	220.87	0.00	2.34	4.0
6	1.60	0.480	305.00	68.0	54.0	61.0	223.21	0.00	2.53	4.0
7	1.38	0.400	280.00	70.0	55.0	62.5	225.73	0.00	2.40	4.0
8	1.30	0.380	276.00	72.0	56.0	64.0	228.18	0.00	2.34	4.0
9	1.60	0.480	300.00	58.0	55.0	56.5	230.46	230.46	2.45	4.0
10	1.65	0.490	300.00	64.0	58.0	61.0	232.91	0.00	2.47	4.0
11	1.50	0.450	300.00	68.0	58.0	63.0	235.30	0.00	2.45	4.0
12	1.50	0.440	300.00	76.0	60.0	68.0	237.83	0.00	2.45	4.0
13	1.50	0.450	298.00	72.0	60.0	66.0	240.28	0.00	2.43	4.0
14	1.50	0.450	300.00	74.0	60.0	67.0	242.71	0.00	2.44	4.0
15	1.20	0.370	288.00	74.0	61.0	67.5	245.15	0.00	2.38	4.0
16	1.20	0.380	285.00	74.0	62.0	68.0	247.44	0.00	2.24	4.0
							249.68			

AYER. 1.46 0.45 293.23 66.5 55.9 61.2 2.41

STACK GAS PRESSURE : PBAR= 29.42 IN HG
 P STAT= 0.01 IN HG, 0.14 IN H2O
 P STACK= 29.43 IN HG

STACK GAS MOISTURE: 3.50 WATER VOLUME IN IMPINGERS= 26.20 ML
 WATER VOLUME IN SILICA GEL= 9.40 ML
 MOISTURE VOLUME (TRAIN)= 1.40 SCF
 MOISTURE FRACTION, BWD = 0.03

SATURATION MOISTURE: 4.8.26
 RELATIVE HUMIDITY: 0.84
 SAMPLING TIME: 64.00
 SAMPLE VOLUME : 38.71

STACK GAS COMPOSITION %CO2= 0.00 %O2= 21.00 %CO= 0.00
 %N2= 79.00 %SO2= 0.00

STACK GAS MOLECULAR WEIGHT: DRY MW-MD 28.84
 WET MW-MW= 28.40
 %ENC. AIR=-14583.33

TRAIN COMPONENTS SPECS: PITOT COEFFICIENT CV= 0.9100
 NOZZLE DIAMETER = 0.2500 INCHES
 METER CORR. FACTOR = 1.0000

STACK DIMENSIONS: DIAMETER= 24.000 INCHES 0.000 INCHES
 AREA = 3.142 SQFT

PRODUCTION RATE : 4.00 TRUCK BODIES-MI

POINT	DH H2O	DP H2O	TS °F	THI °F	TMO °F	VM FT3	DGMV FT3/MIN
1	1.68	0.50	290.0	49.2	50.0	211.11	0.63
2	1.46	0.47	295.0	45.0	54.0	213.61	0.61
3	1.40	0.46	295.0	44.5	54.0	218.05	0.60
4	1.42	0.47	292.0	44.9	57.5	218.46	0.60
5	1.40	0.47	288.0	44.8	59.5	220.87	0.59
6	1.60	0.48	305.0	45.8	61.0	223.21	0.62
7	1.38	0.40	280.0	41.1	62.5	225.73	0.60
8	1.30	0.38	276.0	39.9	64.0	228.18	0.58
9	1.60	0.48	300.0	45.6	56.5	230.46	0.61
10	1.65	0.49	300.0	46.1	61.0	232.91	0.62
11	1.50	0.45	300.0	44.2	63.0	235.30	0.61
12	1.50	0.44	300.0	43.7	68.0	237.83	0.61
13	1.50	0.45	298.0	44.1	66.0	240.28	0.61
14	1.50	0.45	300.0	44.2	67.0	242.71	0.61
15	1.20	0.37	288.0	39.7	67.5	245.15	0.57
16	1.20	0.38	285.0	40.2	68.0	247.44	0.56

4.00 TRUCK BODY & HI

2. **Food intake**

POINT	DH H2O	DP H2O	TS °F	VS FT. SEC	SLUR FT. SEC	TEMP FT. MIN	TIME
1	1.68	0.50	290.0	45.0	0.4	0.63	101.00
2	1.46	0.47	295.0	45.0	0.4	0.61	101.30
3	1.40	0.46	295.0	44.5	0.4	0.60	101.60
4	1.42	0.47	292.0	44.9	0.4	0.60	101.90
5	1.40	0.47	288.0	44.8	0.4	0.59	102.20
6	1.60	0.48	305.0	45.8	0.4	0.63	102.50
7	1.38	0.40	250.0	41.1	0.4	0.60	104.00
8	1.30	0.38	276.0	39.9	0.4	0.58	104.30
9	1.60	0.48	300.0	45.6	0.4	0.61	100.45
10	1.65	0.49	300.0	46.1	0.4	0.62	99.25
11	1.50	0.45	300.0	44.2	0.4	0.61	102.30
12	1.50	0.44	300.0	43.7	0.4	0.61	102.81
13	1.50	0.45	298.0	44.1	0.4	0.61	100.71
14	1.50	0.45	300.0	44.2	0.4	0.61	101.07
15	1.20	0.37	288.0	39.7	0.3	0.57	104.04
16	1.20	0.38	285.0	40.0	0.2	0.56	100.00

SUMMARY OF EMISSION TESTS

COMPANY: GENERAL MOTORS
LOCATION: ELPO #1 STACK (H.F.)
CITY: OSHAWA

TEST # DATE: TEST #1, NOV. 15, 77,
TDA REPORT#: -
DATE REPORT REC'D:
CONSULTANT REPORT #:

EMISSION COMPONENT: PARTICULATES, (IMPRINGER EXCLUDED)

GAS VELOCITY	GAS TEMP.	GAS MOIS.	GAS FLOW	EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
FPS	°F	%	DSO/FM	LB/HR	GM/FT3	LB/TRUCK BODIES
43.7	293.3	3.50	5507.30	6.777E-02	1.436E-03	1.694E-02
MPS	°C	%	DSO/M	GM/SEC	GM/M3	KG/TRUCK BODIES
13.3	145.1	3.50	155.91	8.539E-03	3.285E-03	7.685E-03

EMISSION COMPONENT: PARTICULATES, (IMPRINTERS INCLUDED)

EMISSION RATE	CONCENTRAT. GR/FT3	EMISSION FACTOR	
LB/HR	GR/FT3	LB/TRUCK	BODIES
6.777E-02	1.436E-03	1.694E-02	
GM/SEC	GM/H3	KG/TRUCK	BODIES
8.539E-03	3.285E-03	7.685E-03	

COMPONENT DISTRIBUTION IN SAMPLING TRAIN

		PROSE	CYCLONE	FILTER	IMPINGERS	TOTAL
PARTICULATES, % OF TOTAL PART	(WG)	0.0000	0.0000	3.0000	0.0000	3.0000
		0.0000	0.0000	100.0000	0.0000	100.0000

ISOKINETIC & SAMPLING DATA SUMMARY

AVERAGE %ISOKINETICS 101.33			SAMPLING MIN. 64.00	SAMPLE VOLUME (SCM) 1.00	
READINGS	SUB. ISO	SUPER ISO	ADD. ISO	MINIMUM ISO	ADJUSTING FACTOR
16	0	0	0	100	95% IS + 110 WFL & 100% L
		150	100 ISO		

STAGNATION PRESSURE

CONTRACT: 60000-1-00000
CITY: NEW YORK
LOCATION: EL PASO, TEXAS, H.F.
TEST DATE: 1977-11-16/77

NUMBER OF TRAVERSES: 2.00

PT	DP H2O	DP H2O	TS °F	TMI °F	TMO °F	TR % °F	VS FT/S	VM:LEAD-CH. OR TR.END	DGMV FT/S	TIME MIN
1	1.26	0.485	298.00	53.0	53.0	53.0	113.10	0.00	2.16	4.0
2	1.40	0.480	302.00	55.0	54.0	54.5	115.27	0.00	2.44	4.0
3	1.35	0.470	297.00	57.0	54.0	55.5	117.70	0.00	2.45	4.0
4	1.35	0.470	299.00	59.0	56.0	57.5	120.15	0.00	2.42	4.0
5	1.10	0.460	293.00	59.0	57.0	58.0	122.57	0.00	2.43	4.0
6	1.15	0.470	296.00	62.0	60.0	61.0	124.95	0.00	2.47	4.0
7	1.00	0.370	293.00	62.0	61.0	61.5	127.40	0.00	2.18	4.0
8	1.00	0.380	288.00	62.0	63.0	62.5	129.64	0.00	2.29	4.0
9	1.35	0.470	300.00	57.0	64.0	60.5	131.93	131.93	2.47	4.0
10	1.40	0.460	299.00	57.0	61.0	59.0	134.40	0.00	2.46	4.0
11	1.30	0.460	289.00	57.0	62.0	59.5	136.66	0.00	2.42	4.0
12	1.28	0.470	296.00	55.0	61.0	58.0	139.29	0.00	2.44	4.0
13	1.10	0.415	293.00	54.0	62.0	58.0	141.73	0.00	2.31	4.0
14	1.05	0.415	287.00	54.0	62.0	58.0	144.01	0.00	2.34	4.0
15	0.98	0.350	282.00	52.0	61.0	56.5	146.38	0.00	2.19	4.0
16	0.98	0.340	286.00	53.0	61.0	57.0	148.56	0.00	2.16	4.0
							150.72			

AVG: 1.21 0.44 293.63 56.8 59.5 58.1 2.35

STAGN. GP: PRESSURE: PBAR= 29.25 IN HG
P STAT= 0.01 IN HG, 0.14 IN H2O
P STACK= 29.26 IN HG

STACK GAS MOISTURE: 2.93 WATER VOLUME IN INCHES= 15.90 ML
WATER VOLUME IN SILICA GEL= 8.10 ML
MOISTURE VOLUME (TRAIN)= 1.14 SCF
MOISTURE FRACTION, BWG = 0.03

SATUR. ION MOISTURE: 423.11
RELATIVE HUMIDITY: 0.69
SAMPLING TIME: 64.00
SAMPLE VOLUME: 37.73

STAGN. GAS COMPOSITION %CO2= 0.00 %O2= 21.00 %CO= 0.00
%N2= 79.00 %SO2= 0.00

STAGN. GAS MOLECULAR WEIGHT: DRY MW-MD 28.84
WET MW-MW= 28.92
%EXC. AIR=-14583.33

TRAIN COMPONENTS SPECS: PITOT COEFFICIENT CV= 0.8120
NOZZLE DIAMETER = 0.2500 INCHES
METER CORR. FACTOR = 1.0000

STAGN. DIMENSIONS: DIAMETER= 24.000 INCHES 0.000 INCHES
AREA = 3.142 SQFT

REDUCTION RATE: 4.00 TRUCK BODIES/MI

% ISOKINETIC

POINT	DP H2O	DP H2O	TS °F	VS FT/SEC	DGMV FT/S	DGMO FT/S/MIN	%I
1	1.26	0.49	298.0	46.0	2.16	0.54	87.77
2	1.40	0.48	302.0	45.9	2.44	0.61	99.41
3	1.35	0.47	297.0	45.2	2.45	0.61	100.37
4	1.35	0.47	299.0	45.3	2.42	0.60	98.77
5	1.10	0.46	293.0	44.6	2.43	0.61	99.72
6	1.15	0.47	296.0	45.2	2.47	0.62	100.00
7	1.00	0.37	293.0	40.6	2.18	0.55	87.77
8	1.00	0.38	288.0	40.4	2.29	0.57	102.32
9	1.35	0.47	300.0	45.3	2.47	0.62	100.62
10	1.40	0.48	299.0	45.0	2.46	0.62	99.36
11	1.30	0.46	289.0	44.0	2.42	0.61	99.15
12	1.28	0.47	296.0	45.2	2.44	0.61	99.52
13	1.10	0.42	293.0	42.4	2.31	0.58	99.77
14	1.05	0.42	287.0	42.3	2.34	0.59	101.04
15	0.98	0.35	282.0	38.7	2.19	0.55	102.54
16	0.98	0.34	286.0	38.2	2.16	0.54	102.88

PRODUCTION RATE : 4.00 TRUCK BODIES/HI

% ISOKINETIC

POINT	DH H2O	DP H2O	TS °F	VS FT/SEC	DCMH FTS	DCMU FTS/MIN	%
1	1.26	0.49	298.0	46.0	2.16	0.54	87.77
2	1.40	0.48	302.0	45.9	2.44	0.61	99.41
3	1.35	0.47	297.0	45.2	2.45	0.61	100.37
4	1.35	0.47	299.0	45.3	2.42	0.60	98.77
5	1.20	0.46	293.0	44.6	2.43	0.61	99.72
6	1.35	0.47	296.0	45.2	2.47	0.62	100.06
7	1.00	0.37	293.0	40.0	2.11	0.53	91.11
8	1.00	0.38	288.0	40.4	2.29	0.57	102.32
9	1.35	0.47	300.0	45.3	2.47	0.62	100.62
10	1.40	0.48	299.0	45.8	2.46	0.62	99.36
11	1.30	0.46	289.0	44.5	2.42	0.61	99.15
12	1.28	0.47	296.0	45.2	2.44	0.61	99.52
13	1.10	0.42	293.0	42.4	2.31	0.58	99.77
14	1.05	0.42	287.0	42.2	2.34	0.59	101.04
15	0.98	0.35	282.0	38.7	2.19	0.55	102.54
16	0.98	0.34	286.0	38.2	2.16	0.54	102.88

SUMMARY OF EMISSION TESTS

COMPANY: GENERAL MOTORS
LOCATION: ELPO #1 STACK (H.F.)
CITY: OSHAWA

TEST & DATE: TEST #1, NOV. 16/77;
TDA REPORT#: -
DATE REPORT REC'D:
CONSULTANT REPORT #:

EMISSION COMPONENT: PARTICULATES

(IMPRINGER EXCLUDED)

GAS VELOCITY	GAS TEMP.	GAS MOIS.	GAS FLOW	EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
FPS	°F	%	DSCFH	LB/HR	GR/FT3	LB/TRUCK BODY
43.4	293.6	2.93	5466.59	7.667E-03	1.636E-04	1.917E-03
MPS	°C	%	DSCMH	GM/SEC	GM/M3	KG/TRUCK BODIES
13.2	145.3	2.93	154.76	9.660E-04	3.744E-04	8.694E-04

EMISSION COMPONENT: PARTICULATES

(IMPRINGERS INCLUDED)

EMISSION RATE	CONCENTRAT.	EMISSION FACTOR
LB/HR	GR/FT3	LB/TRUCK BODIES
7.667E-03	1.636E-04	1.917E-03
GM/SEC	GM/M3	KG/TRUCK BODIES
9.660E-04	3.744E-04	8.694E-04

COMPONENT DISTRIBUTION IN SAMPLING TRAIN

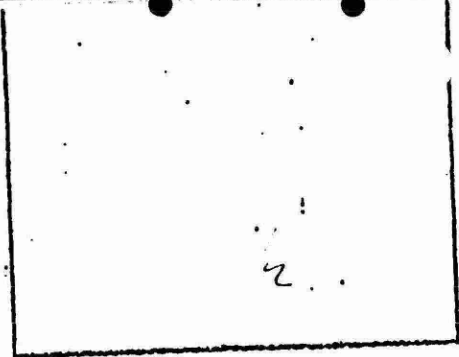
	PROBE	CYCLONE	FILTER	IMPRINGERS	TOTAL
PARTICULATES (MG)	0.0000	0.0000	0.4000	0.0000	0.4000
% OF TOTAL PART	0.0000	0.0000	100.0000	0.0000	100.0000

ISOKINETIC & SAMPLING DATA SUMMARY

AVERAGE %ISOKINETICS		SAMPLING MIN.		SAMPLE VOLUME (SCM)	
99.53		64.00		1.07	
READINGS	SUB.ISO	SUPERISO	NON.ISO	%WITHIN ISO	ACCEPTILITY FACTOR
16	1	0	1	94	95 ISO 110 WELL MTD.
		ISO	NONISO		
		16	9	100	95 ISO 110 WELL MTD.

Location CA - 102 Stack
 Operator J Mc HF
 Date Nov 16/77
 Run No. ALPE #1
 Sample Box No. C-II
 Control Module No.
 Meter (ΔH)
 C Factor .812

Schematic of



Cross Section
 Assumed Moisture (%). 2.0
 Heater Box Setting ($^{\circ}$ F). 270
 Probe Length (in.). 6'
 Nozzle Diameter (in.). .25
 Nozzle Area (Sq. in.).
 STATIC PRESSURE .01

VAC - 2" Hg - 2.5

FIELD SAMPLING DATA SHEET CHART

Traverse Point Number	Sampling Time (H) Min.	Stack Temp. Ts ($^{\circ}$ F)	Velocity Head (ΔP_s)	Velocity (Ft./sec)	Orifice Pressure Diff. (ΔH) in. H ₂ O	Gas Sample Volume (Vm) Cu. Ft.	Gas Temperature At Dry Gas Meter		Sample Box Temp. of	Probe Temp. ($^{\circ}$ F)
							Inlet (Tm in.) OF	Outlet (Tm out) OF		
1-A	0	298	.485		1.26	113.102	53	53	324/50	307
	4	302	.48		1.40	115.265	55	54		
2-A	8	297	.47		1.35	117.702	57	54		
	12	299	.47		1.35	120.150	59	56		
3-A	16	298 293	.46		1.20	122.565	59	52		
	20	296	.47		1.35	124.990	62	60		
4-A	24	293	.37		1.0	127.458	62	61		
	28	288	.39		1.0	129.637	62	63		
	32					131.927				
1-B	0	300	.47		1.35	131.927	57	64	323/44	319
	4	299	.48		1.40	134.40	57	61		
2-B	8	299	.46		1.30	136.862	57	62		
	12	296	.47		1.28	139.286	55	61		
3-B	16	293	.415		1.10	141.727	54	62		
	20	287	.415		1.05	144.032	54	62		
4-B	24	284 2	.35		.98	146.376	52	61		
4-B	28	286	.34		.98	148.562	53	61		
	32					150.720				

PLANT Gravel - Truck
 LOCATION Hippie Creek, Stack #01
 TEST A (duplicate)

DATE Nov. 16/77
 OPERATORS _____
 ANALYST _____

MOISTURE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF MOISTURE (gm.)
IMPINGER # 1	665.2	655.5	9.7
IMPINGER # 2	658.8	654.8	4.0
IMPINGER # 3	524.1	521.9	2.2
IMPINGER # 4	692.6	684.5	8.1
TOTAL			
MOISTURE VOLUME			24 ml.

15.9

PARTICULATE DATA

	FINAL WEIGHT (gm.)	TARE WEIGHT (gm.)	WEIGHT OF PARTICULATE (gm.)
✓ FILTER #14	0.4050	0.4046	0.0004
BEAKER WITH (PROBE - NOZZLE - CYCLONE) WASHINGS			
CYCLONE FLASK	—	—	—
BEAKER WITH (IMPINGER FILTER-HOLDER) CONTENTS AND WASHINGS			
TOTAL (gm.)			
PARTICULATES IN (mg.)			0.4000

Washing
 25
 130
 314

APPENDIX C

ANALYSIS OF SAMPLES FOR
ODOUR, TOTAL ORGANIC ACID AND TOTAL ALDEHYDE
ONTARIO RESEARCH FOUNDATION

Report APS 79-23-1

Analysis of Samples for
Odour, Total Organic Acid
and Total Aldehyde
for
Air Resources Branch,
Ministry of the Environment,
880 Bay Street,
Toronto, Ontario.
M5S 1Z8

Michael Rix
Dept. of Environmental Chemistry

August 20, 1979

ONTARIO RESEARCH
FOUNDATION

SHERIDAN PARK RESEARCH COMMUNITY

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Analysis of Samples for
Odour, Total Organic Acid
and Total Aldehyde
(APS 79-23)

for

Air Resources Branch,
Ministry of the Environment,
880 Bay Street,
Toronto, Ontario.
M5S 1Z8

1. SUMMARY

Sixteen odour samples, eight organic acid samples, and eight aldehyde samples were analyzed. Odour threshold values (OTVs) ranged from 170 to 4850. Organic acid values ranged from 33 ppm to 90 ppm. Aldehyde concentrations were from 2.6 to 13.7 ppm. Odour threshold values showed some correlation with aldehyde concentrations, for samples from the same stacks.



Michael Rix
Assistant Research Scientist
Dept. of Environmental Chemistry

MR/id

August 20, 1979

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2. INTRODUCTION

Sixteen odour samples, eight sodium hydroxide impinger solutions and blanks, and eight sodium bisulfite impinger solutions and blanks were delivered by the Ministry of the Environment (MOE) to the Ontario Research Foundation (ORF) for analysis for odour threshold, total organic acids and total aldehydes respectively. Data sheets were included with the samples, and are appended to this report.

The samples were obtained from automotive oven emissions from July ³~~7~~, 1979, to July 6, 1979. ←

3. METHODOLOGY

The methodology used for each analysis is outlined below.

3.1 Odour

The odour samples were evaluated by a six-member odour panel in the odour test facility at ORF. The dynamic flow system shown in Figure 1 was used to dilute the sample for presentation to the panel members. Each sample bag is pressurized in a pressure vessel and sample flow from the bag is metered through one of the three rotameters at a pre-determined rate. The sample is diluted with odour-free air and passes through a stainless steel line to one of two 'sniff-ports' in each cubicle for evaluation. Odour evaluations are made for a series of dilutions by each panelist and their response is recorded electronically by pushing a button. The odour test facility operator records the responses at each dilution given and plots the percentage response against dilution number to determine an odour threshold value for each sample. A typical plot is shown as Figure 2. The odour threshold value (OTV) is defined as that dilution of the sample which produces a response by 50% of the panel.

3.2 Organic Acids

The organic acid analyses were performed according to the Los Angeles Air Pollution Control Directorate Source Testing Manual (Appendix A) except for the following changes:

1. A 25 ml aliquot of each sample was used.
2. The samples were acidified using a 300 ml flask and condenser, with shaking during heating, rather than the three-necked flask system.
3. Samples were extracted twice using 100 ml of ethyl ether each time, by shaking with a wrist action mechanical shaker for 5 minutes. This extraction is more complete, and much less tedious than the LA-APCD method.

3.3 Aldehydes

The LA-APCD method (Appendix A) was used for the total aldehydes analysis. Aliquots of 25 mls of sample or blank were used for the analysis.

4. RESULTS AND DISCUSSION

The results of the analyses are given in Tables 1, 2 and 3 for organic acid, aldehydes, and odour respectively. Concentrations in ppm by volume were calculated using the equations in the LA-APCD Source Testing Manual (Appendix A), and the data included with the samples (Appendix B). ~~The normality of the NaOH solution used for the organic acid analysis was 0.09103N. A 0.00482N iodine solution was used for the aldehydes analysis.~~

The differences between the prediluted and non-prediluted odour samples indicate an odour condensation effect for the non-prediluted samples. Therefore, the OTVs for the prediluted samples should be considered the more reliable. The odour values show some correlation with aldehyde concentrations but not with organic acid concentrations.

Q-09103

TABLE 1 - Total Organic Acids Analysis

Sample	Total Sample Volume (ml)	Aliquot Factor f	Titration volumes (ml)		$V_s - V_b$ (ml)	Volume of Stack Gas V_T (ACF) meter	Concentration of O.A. (ppm)	
			Sample V_s	Blank V_b				
GM-4-001	845 ✓	33.80	1.06	0.20	0.86	30.2 ✓ 28.43	73	77.67
GM-4-003	663 ✓	26.52	0.68	0.20	0.48	29.02 ✓ 28.01	33	34.56
GM-2-005	678 ✓	27.12	1.08	0.20	0.88	26.396 ✓ 25.89	67	70.50
GM-2-008	710 ✓	28.40	1.32	0.20	1.12	26.889 ✓ 25.82	90	93.69
GM-3-010	730 ✓	29.20	1.13	0.20	0.93	26.055 ✓ 25.30	79	81.64
GM-3-012	690 ✓	27.60	1.10	0.20	0.90	25.89 ✓ 25.30	73	61.65
GM-1-014	774 ✓	30.96	1.05	0.16	0.89	25.487 ✓ 24.62	82	81.12
GM-1-015	652 ✓	26.08	1.09	0.16	0.93	24.447 ✓ 23.55	75	78.32

TABLE 2 - Total Aldehydes Analysis

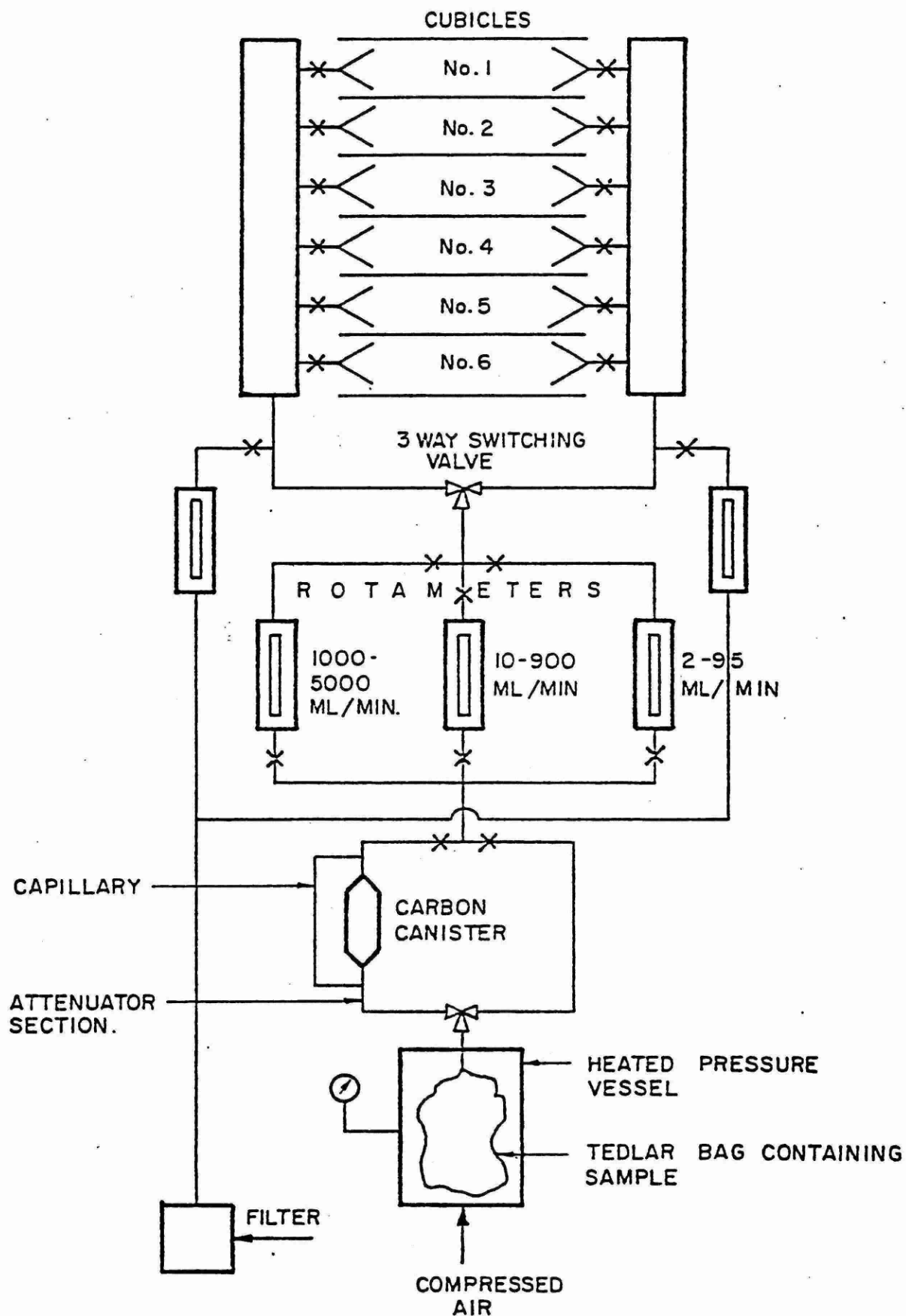
Sample	Total Sample Volume (ml)	Aliquot Factor f	Titration volumes (ml)		$V_s - V_b$ (ml)	Volume of Stack Gas V_T (ACF) (scf)	Concentration of T.A. (ppm)	
			Sample V_s	Blank V_b			V_T (scf)	
GM-1-002	703 ✓	28.12	3.87	0.10	3.77	40.424 - 37.78	5.3	5.04
GM-1-004	700 ✓	28.00	2.73	0.10	2.63	45.702 - 42.65	3.2	3.07
GM-3-006	770 ✓	30.20	6.62	0.10	6.52	44.251 - 42.64	9.1	9.22
GM-3-007	780 ✓	31.20	5.57	0.10	5.47	44.063 - 42.09	7.7	8.15
GM-2-009	750 ✓	30.00	10.23	0.10	10.13	46.166 - 33.26	13.2	11.12
GM-2-011	645 ✓	25.80	13.19	0.10	13.09	49.743 - 36.98	13.7	14.15
GM-4-013	700 ✓	28.00	2.46	0.11	2.35	47.96 - 44.38	2.8	2.77
GM-4-016	646 ✓	25.84	2.57	0.11	2.46	48.52 - 45.15	2.6	2.82

TABLE 3 - Odour Evaluations

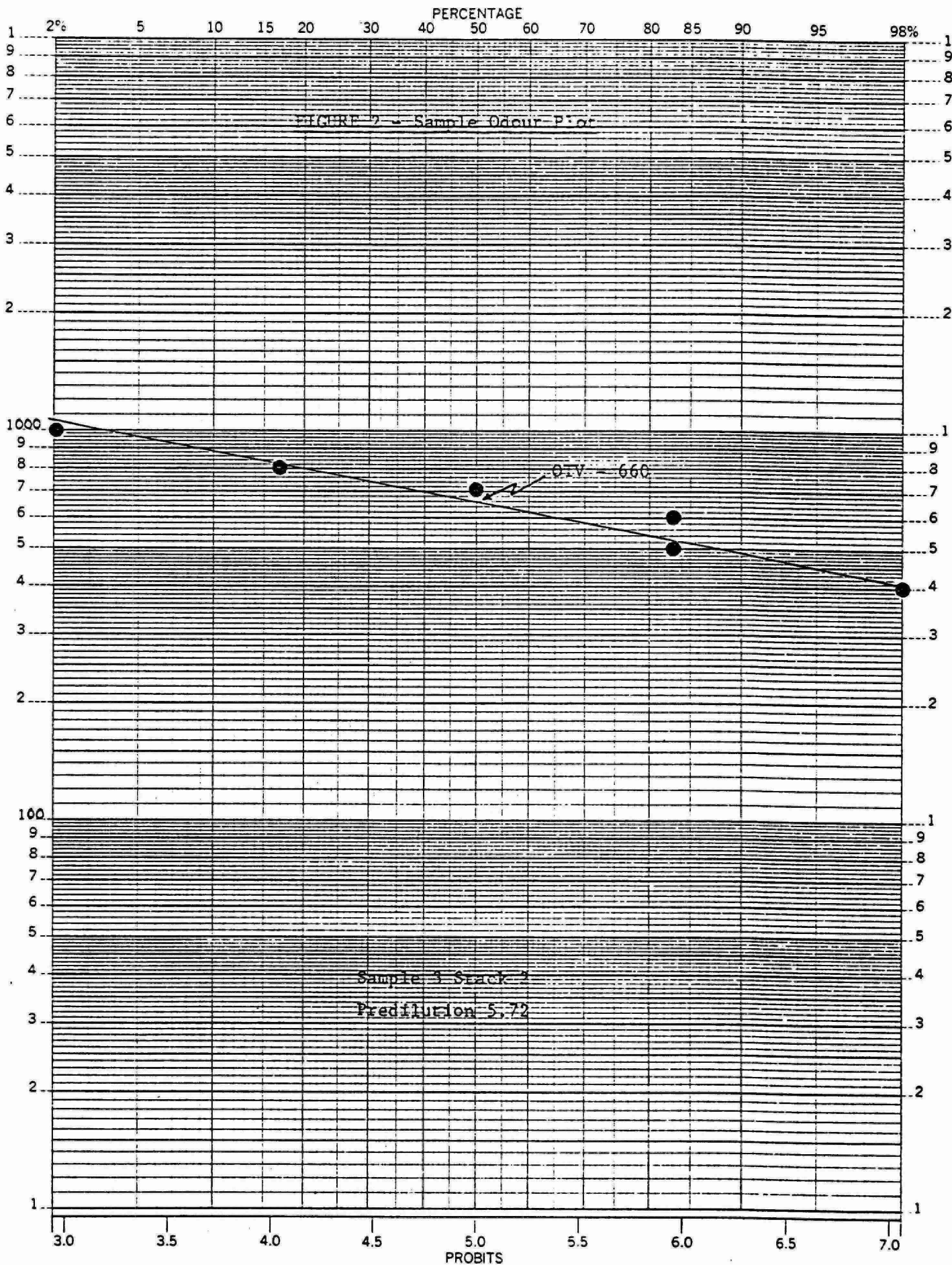
Sample #	Stack	Predilution	OTV*
1	"Gary"	-	450
2	"Gary"	-	650
3	2	5.7X	3760
4	2	5.7X	4850
1	1	-	260
2	1	-	170
3	1	5.7X	1600
4	1	5.7X	485
1	3	-	280
2	3	-	200
3	3	5.7X	1140
4	3	5.7X	2570
1	4	-	300
2	4	-	320
3	4	4.3X	770
4	4	4.3X	990

*Includes predilution factor

FIGURE 1



O.R.F. DYNAMIC FLOW SYSTEM FOR EVALUATION OF ODOURS.



46 8080

PROBABILITY X 3 LOG CYCLES
NEUFEL & FESSER CO. MADE IN U.S.A.

APPENDIX A

Los Angeles APCD
Source Testing Manual
Organic Acids and Aldehydes

Collection and Analysis of Gaseous Constituents

n_4 = exact normality of the 0.1 N sodium hydroxide used for the blank titration

f = aliquot factor: the ratio of total solution volume to aliquot volume

In usual cases, $v_1 = v_3$, $n_1 = n_3$, and $n_2 = n_4$, and Equation 5.1 reduces to

$$W_{NH_3} = 0.0170fn_2(v_4 - v_2). \quad (5.2)$$

The concentration of ammonia in the gas sample is given by the two relations:

$$C_{NH_3} = 15.43 \frac{W_{NH_3}}{V_T}, \quad (5.3)$$

$$S_{NH_3} = 49,200 \frac{W_{NH_3}}{V_T}, \quad (5.4)$$

where,

C_{NH_3} = concentration of ammonia, grains per standard cubic foot

S_{NH_3} = concentration of ammonia, parts per million by volume

V_T = total sampled volume from Equation 4.9, standard cubic feet

5.4.1.6.3 Emission Rate

The emission rate, or mass flow rate, of ammonia at the sampling station location is given by either of the two relations:

$$M_{NH_3} = 0.00857 C_{NH_3} Q, \quad (5.5)$$

or

$$M_{NH_3} = 2.69 \times 10^{-6} S_{NH_3} Q, \quad (5.6)$$

where,

M_{NH_3} = emission rate of ammonia, pounds per hour

C_{NH_3} = concentration, from Equation 5.3, grains per standard cubic foot

S_{NH_3} = concentration, from Equation 5.4, parts per million by volume

Q = stack gas flow rate, from Equation 3.12, standard cubic feet per minute

5.4.1.6.4 Moisture Content

The water vapor content of the stack gases is calculated by the procedure described in Section 4.4.1.8.3. The calculation is made only for comparison with the results from the particulate train processing. The difference is due to possible small errors in condensate volume and water vapor volume calculations, caused by chemical reactions during absorption and by the lowered vapor pressure (relative to pure water) of the absorbent solution. It may be noted, however, that the errors in the case of ammonia collection are smaller than those when using an alkaline absorbent solution for collection of acidic constituents.

5.4.2 ORGANIC ACIDS

5.4.2.1 METHOD SUMMARY

The only collection method used by the APCD for organic acids is continuous sampling with an impinger absorption train. The procedure entails the collection of the sample by bubbling the gases through dilute caustic followed by acidification and ether extraction of the free organic acids. A liquid-liquid extractor is used to provide multiple contact of ether and aqueous media. The organic acids in ether are subsequently titrated with a standard base and reported as acetic acid. The lower limit of the method is about 0.2 ppm in a 60 cubic foot sample.

Aliquot portions of the impinger solution can also be analyzed for total oxides of sulfur (see Sect. 5.4.7).

4.2.2 PREPARATION FOR SAMPLING

The collection train is assembled as shown in Figure 5.1. The first two impingers each contain exactly 100 ml of 5% sodium hydroxide solution, while the third is operated dry to catch any carry-over spray and to protect the meter. An ice bath is used to cool the impingers. Glass, quartz-composition, or stainless steel sampling probes of any convenient type may be used. All equipment is tested for proper operation and freedom from leaks.

5.4.2.3 SAMPLING

Any convenient sampling rate, not to exceed 100 cfm, may be used. Proportional sampling, as described in Section 5.2.1, may be necessary when there are wide fluctuations in both gas flow rate and composition.

The data recorded during sampling should include:

- a) Time (clock) of test and data recordings
 - b) Gas meter reading (initial), cubic feet
 - c) Gas meter vacuum, inches of mercury below atmospheric
 - d) Gas meter temperature, degrees Fahrenheit
 - e) Temperature of gas at exit of third impinger, degrees Fahrenheit.
- Readings may be taken at five- or ten-minute intervals during a one-hour test, and the data are recorded as indicated on the upper tabular portion of Figure 4.9. Sampling for particulate matter usually accompanies this procedure; if this is not the case, reference point velocity head and temperature readings should be made, as described in Section 3.3.2.

At the completion of sampling, the pump is shut off and the train allowed to come to atmospheric pressure before disconnecting the vacuum line. The final gas meter reading is

recorded. The impingers and associated tubing are suitably sealed for transfer to the laboratory for processing. Condensate, if any, in the probe and inlet tubing is allowed to flow into the first impinger.

5.4.2.4 SAMPLE PROCESSING

The total volume of liquid contained in the impingers is carefully measured. The difference from the initial volume is recorded as the condensate volume.

The impingers and associated tubing are carefully rinsed with small portions of distilled water, the liquid and washings being kept in a beaker or flask. If aliquots are to be taken for analysis, the combined liquid and washings are made up to an exact volume. Aliquots can be taken if the organic acids exceed 50 ppm by volume.

5.4.2.5 ANALYTICAL PROCEDURE

The reagents needed for the analysis are concentrated sulfuric acid, reagent-grade ethyl ether, and 0.1 N sodium hydroxide solution. The 0.1 N sodium hydroxide solution should be prepared and stored in a manner to avoid contamination by atmospheric carbon dioxide. The solution is standardized by titration using potassium biphthalate (primary-standard grade) and phenolphthalein indicator.

The liquid-liquid extractor (Item No. 92232, Corning Glass Works, Corning, New York, or equivalent) and water heating bath are shown disassembled in Figure 5.5. The procedure for each sample is as follows:

An 80-100 ml aliquot of the solution is transferred to a 500-ml three-neck glass flask equipped with a reflux condenser, separatory funnel, and gas inlet tube. The latter should project below the level of the liquid in the flask. Four drops of methyl red indicator are added and the sample is acidified by addition

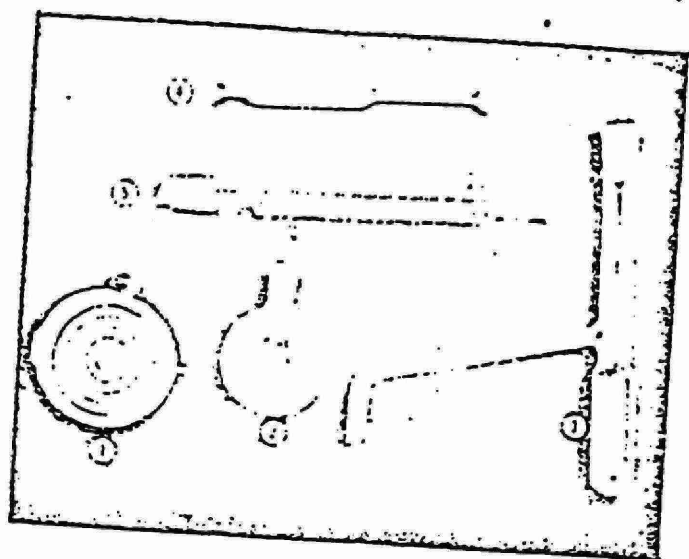


FIGURE 5.5. Equipment used for extraction of organic acids. Equipment shown is (1) steam bath; (2) round bottom flask; (3) extractor; (4) inner collector tube; (5) condenser.

If concentrated sulfuric acid from the separatory funnel. During acidification, the sample is agitated by intermittent bubbling of nitrogen into the flask. After acidification, nitrogen is bubbled through the sample until sulfur dioxide ceases to evolve from the condenser (determined by holding wet litmus test paper strips at the top of the condenser). The sample is now heated just to the boiling point to ensure complete removal of SO_2 . The sample is allowed to cool and the condenser is rinsed with water into the flask. The sample is transferred to a volumetric flask and diluted to a table exact volume. Fifty ml aliquots are transferred to 150-ml beakers and adjusted to pH 2 (pH paper) with 30% sodium hydroxide solution. A blank containing the same amount of original sodium hydroxide as the aliquots is adjusted to pH 2 with concentrated sulfuric acid and is analyzed with the aliquot samples.

Transfer the sample and blank mixtures to separate 500-ml liquid-liquid extractors. A long-stemmed funnel is useful for making the transfers. The final aqueous levels should be 3 or 4 inches below the side arms. Carefully insert the inner collector tubes, and attach

the condensers and 500-ml round bottom flasks. Slowly add ether through the condensers, allowing it to rise in the extractors. Continue adding ether until about 200 ml has overflowed into the flasks. Heat the flasks to steady boiling on water baths or with Glass-Col heating mantles, and allow the extractions to proceed for 8 hours.

After the flasks have cooled, tilt the extractors to allow as much as possible of the ether to decant over into the flasks without removing any aqueous material. Transfer the ether extracts to separatory funnels and remove any traces of aqueous material that may be present. Add about 40 ml of water and 3 drops of phenolphthalein indicator to each of the ether solutions in the separatory funnels. Titrate the mixtures in the funnels with standard 0.1 N sodium hydroxide to the phenolphthalein end point. As the end point is approached, stopper the separatory funnels and shake with each small titration increment until a pink color persists.

5.4.2.6 CALCULATIONS

The sequence of calculations, using the data obtained during sampling, processing, and analysis, is as follows:

- Volume of stack gas sampled
- Organic acid concentration
- Emission rate of organic acids
- Water vapor content of stack gas

The APCD forms shown in Figures 4.9 and 4.13 are convenient for many of the calculations to be described.

5.4.2.6.1 Sample Volume

The volume of stack gas sampled is calculated in the same manner as described for ammonia (Sect. 5.4.1.6.1). It may be noted that a slight error occurs in the sample volume calculation when stack gases containing moderate amounts of carbon dioxide are sampled with absorption trains containing sodium hydroxide

solution. The alkali will react with the carbon dioxide, forming water, sodium carbonate, and possibly some bicarbonate. The pH of the resulting solution is still high enough, however, for efficient absorption of oxides of sulfur, organic acids, or fluorides. As a result of this reaction, the measured condensate volume will be high due to production of water, and the metered gas volume will be low due to loss of a small volume of carbon dioxide from the gas sample. These two small errors will tend to cancel each other for calculation of total sample volume.

5.4.2.6.2. Concentration

The weight of organic acids (expressed as acetic acid) collected by the sampling train is given by

$$W_{OA} = 0.0601fn(v_s - v_b) \quad (5.7)$$

where,

W_{OA} = weight of organic acids, grams

f = aliquot factor: the ratio of total solution volume to aliquot volume

n = exact normality of 0.1 N sodium hydroxide

v_s = volume of 0.1 N sodium hydroxide used for the sample titration, milliliters

v_b = volume of 0.1 N sodium hydroxide used for the blank titration, milliliters

The concentration of organic acids in the gas sample is given by the two relations,

$$C_{QA} = 15.53 \frac{W_{OA}}{V_T} \quad (5.8)$$

$$c_{QA} = 13,900 \frac{W_{OA}}{V_T} \quad (5.9)$$

where,

C_{QA} = concentration of organic acids (as acetic acid), grains per standard foot.

c_{QA} = concentration of organic acids, parts per million by volume

V_T = volume of stack gas sampled, from Equation 4.9, standard cubic feet

Although weight-volume concentrations (Eq. 5.8) require that some particular acid such as acetic be used as a basis, volume-volume concen-

trations (Eq. 5.9) will be the same for any monocarboxylic acid.

5.4.2.6.3 Emission Rate

The emission rate of organic acids at the sampling station location is given by either of the two relations,

$$M_{OA} = 0.00857 C_{QA} Q \quad (5.10)$$

or

$$M_{OA} = 9.52 \times 10^{-6} c_{QA} Q \quad (5.11)$$

where,

M_{OA} = emission rate of organic acids, pounds per hour

C_{QA} = concentration, from Equation 5.8, grains per standard cubic foot

c_{QA} = concentration, from Equation 5.9, parts per million by volume

Q = stack gas flow rate, from Equation 3.12, standard cubic feet per minute

5.4.2.6.4 Moisture Content

The water vapor content of the stack gases is calculated by the procedure described in Section 4.4.1.8.3. The calculation is made only for comparison with the results from the particulate train processing. The difference is due to errors in condensate volume and water vapor volume calculations, caused by chemical reactions during absorption and the lowered vapor pressure (relative to pure water) of the absorbent solution. Both effects mentioned will produce small positive errors in calculation of water vapor content.

5.4.3 ALDEHYDES

5.4.3.1 METHOD SUMMARY

In practically all tests, samples for aldehyde analysis are collected in evacuated flasks, using grab sampling techniques (Sect. 5.3.2). In rare instances, impinger absorption trains have been used, but this collection method is more applicable to the low aldehyde

Collection and Analysis of Gaseous Constituents

concentrations experienced in atmospheric monitoring.

In either case, aldehydes in the sample react with a solution of sodium bisulfite to form addition compounds. The excess bisulfite ion is destroyed with iodine solution. By adjusting the pH of the solution, the addition compounds are decomposed, freeing bisulfite ion equivalent to the aldehydes present in the sample. The liberated bisulfite ion is then titrated with standard iodine. Methyl ketones, if present in the sample, will be included in the results. The lower limit of the method, using 2-liter gas samples, is about 1 ppm.

Since the collection methods are identical, aliquot portions of the solutions can be analyzed for formaldehyde alone (Sect. 5.4.4).

5.4.3.2 PREPARATION FOR SAMPLING

Two-liter round bottom flasks, as shown in Figure 5.2, are used for grab sampling. Ten ml of 1% sodium bisulfite solution (1g per 100 ml solution) are added to each flask. The flask is then evacuated to the vapor pressure of the solution, the screw clamp closed, and the solid glass plug inserted into the open end of the tubing until ready for sampling.

For continuous sampling by impingers, the collection train is prepared as described for ammonia or organic acids, adding exactly 100 ml of 1% sodium bisulfite solution to each of the first two impingers.

5.4.3.3 SAMPLING

The inlet tube of the 2-liter flask is connected to one leg of a glass tee or three-way stopcock attached to the sampling line. An aspirator bulb, connected to the other leg of the tee, is used for flushing the sample probe and tubing with stack gas just prior to sampling, as illustrated in Figure 5.6. The

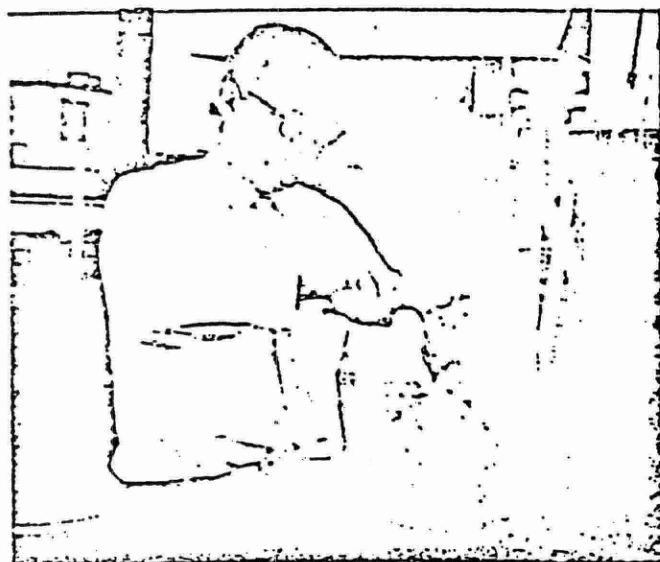


FIGURE 5.6.. Grab sampling of a gas stream.

screw clamp is opened to admit gas to the evacuated flask. When the flow of gas has ceased, the screw clamp is closed and the glass plug reinserted into the short rubber tube to the flask. The flow of gas may continue for many minutes when the gases are almost 100 per cent steam, thus requiring the flask to be cooled during this process. Such a situation may be encountered, for example, when testing rendering cookers. The procedure in Section 5.5.3 should then be followed for calculations. In order to obtain an average value, four grab samples are usually taken during an hour test.

When absorption impinger trains are used, the sampling procedure is the same as described for organic acids. The sampling rate should not exceed 0.3 cfm.

5.4.3.4 SAMPLE PROCESSING

The sealed collection flasks are shaken for 15 minutes on a mechanical shaker, with frequent rotation to provide a thorough scrubbing action. The temperature and absolute gas pressure in each flask are recorded after the gases have reached ambient temperature. The contents of each sample flask are then rinsed

into conical flasks. A blank is prepared, using the same amount of 1% sodium bisulfite solution used for each sampling flask.

The impinger train collection is processed in a manner analogous to that described for organic acids in Section 5.4.2.4. Unless the aldehyde concentration is very low (below 0.1 ppm), aliquots may be taken for analysis.

5.4.3.5 ANALYTICAL PROCEDURE

The analytical procedure is identical for samples collected either by grab or absorption train sampling.

The reagents needed for the analysis are 0.05 N sodium thiosulfate solution, 0.005 N iodine solution, approximately 0.1 N iodine solution (made by dissolving 12.7 g of iodine in a solution of 25 g of potassium iodide in 50 ml of water, and diluting to one liter with water), and a special buffer solution. The sodium thiosulfate solution is standardized with potassium dichromate (primary standard grade) according to standard iodometric procedure. The 0.005 N iodine solution, prepared by dilution from the 0.1 N solution, is standardized by titration with the sodium thiosulfate solution using starch indicator. The buffer solution is prepared by dissolving 30 g of anhydrous sodium carbonate in 500 ml of water, slowly adding 20 ml of glacial acetic acid, followed by dilution to 1 l. The pH of the solution is adjusted to 9.6 ± 0.1 with sodium carbonate or acetic acid, as required, using a pH meter.

Two ml of 1% starch indicator solution are added to each sample, and 0.1 N iodine is added dropwise until a dark blue color is produced. Care should be taken to ensure that all of the sulfur dioxide resulting from the decomposition of bisulfite is removed since it may cause the end point to fade. This can be con-

veniently accomplished by blowing a small jet of air into the flask while swirling the contents vigorously for several minutes. Each solution is decolorized by dropwise addition of 0.05 N sodium thiosulfate. The 0.005 N iodine solution is added, to a faint blue end point. The solutions are cooled thoroughly in an ice bath, and 50 ml of chilled buffer are added to each flask. The flasks are kept in the ice bath for 10 to 15 minutes after the buffer addition. The liberated bisulfite is titrated with 0.005 N iodine solution to the same faint blue end point present before addition of the buffer. The sample must remain chilled in order to avoid a fading end point.

5.4.3.6 CALCULATIONS: IMPINGER TRAIN SAMPLES

The sequence of calculations for aldehyde samples collected by impinger trains is as follows:

- a) Volume of stack gas sampled
- b) Aldehyde concentration
- c) Emission rate of aldehydes

5.4.3.6.1 Sample Volume

The calculations for the volume of stack gas sampled are made in the same manner as described previously, in Section 5.4.1.6, for ammonia.

5.4.3.6.2 Concentration

The weight of aldehydes, expressed as formaldehyde, collected by the impinger train is given by the expression

$$W_{\text{ALD}} = 0.015fn(v_s - v_b) \quad (5.12)$$

where,

W_{ALD} = weight of aldehydes collected, grams

f = aliquot factor: ratio of total solution volume to aliquot volume

n = exact normality of the 0.005 N iodine solution

Collection and Analysis of Gaseous Constituents

v_s = volume of 0.005 N iodine solution used for sample titration following the addition of the buffer solution, milliliters

v_b = volume of 0.005 N iodine solution used for blank titration, milliliters

The concentration of aldehydes in the gas sample is given by the two relations,

$$C_{ALD} = 15.43 \frac{W_{ALD}}{V_T} \quad (5.13)$$

and

$$C_{ALD} = 27,800 \frac{W_{ALD}}{V_T} \quad (5.14)$$

where,
 C_{ALD} = concentration of aldehydes (as formaldehyde), grains per standard cubic foot

C_{ALD} = concentration of aldehydes, parts per million by volume

V_T = total sampled volume, from Equation 4.9; standard cubic feet

Unlike weight-volume concentration, volume-volume concentrations will be the same for any aldehyde or methyl ketone having one carbonyl group per molecule.

5.4.3.6.3 Emission Rate

The emission rate, or mass flow rate, of aldehydes at the sampling station location is given by either of the two relations,

$$M_{ALD} = 0.00857 C_{ALD} Q \quad (5.15)$$

or

$$M_{ALD} = 4.75 \times 10^{-6} C_{ALD} Q \quad (5.16)$$

where,

M_{ALD} = emission rate of aldehydes, pounds per hour

C_{ALD} = concentration, from Equation 5.13, grains per standard cubic foot

C_{ALD} = concentration, from Equation 5.14, parts per million by volume

Q = stack gas flow rate, from Equation 3.12, standard cubic feet per minute

5.4.3.7 CALCULATIONS: GRAB SAMPLES

The sequence of calculations for aldehyde samples collected with evacuated flasks is as follows:

- Volume of stack gas sampled, dry basis
- Aldehyde concentration, dry basis
- Aldehyde concentration, stack conditions
- Emission rate of aldehydes

5.4.3.7.1 Sample Volume

The dry volume of stack gas sampled is calculated as follows:

$$V_{dg} = \frac{V_f(P_f - P_{H_2O})520}{760 T_f}$$

$$= 0.685 \frac{V_f(P_f - P_{H_2O})}{T_f} \quad (5.17)$$

where,

V_{dg} = volume of dry stack gas sampled, liters at standard conditions (60 F, 14.7 psia)

V_f = volume of sampling flask, less volume of absorbent solution, liters

P_f = absolute pressure in flask, millimeters of mercury

P_{H_2O} = vapor pressure of water at temperature T_f , millimeters of mercury

T_f = temperature in flask, degrees Rankine

Volumes of the grab samples are not converted to the stack basis (i.e., actual volume of stack gas sampled) because moisture content data for each grab sample of stack gas are not usually available. As a matter of fact, the

APPENDIX B

Organic Acid and Aldehyde Data

SOURCE:

SAMPLE DATE:

TIME: START

FINISH

SAMPLE #

SAMPLE VOLUME:

ml

GAS VOLUME:

A SCF

SAMPLING RATE:

A CFM

ANALYSIS DATE:

RESULTS:

POLLUTANT TYPE: ALDEHYDE

SOURCE:

SAMPLE DATE:

TIME: START

FINISH

SAMPLE #

SAMPLE VOLUME:

ml

GAS VOLUME:

A SCF

SAMPLING RATE:

A CFM

ANALYSIS DATE:

RESULTS:

POLLUTANT: ORGANIC ACID

SOURCE:

SAMPLE DATE:

TIME: START

FINISH

SAMPLE #

SAMPLE VOLUME:

ml

GAS VOLUME:

A SCF

SAMPLING RATE:

A CFM

ANALYSIS DATE:

RESULTS:

POLLUTANT: ALDEHYDE

SOURCE: GM ELPO STACK # 1
SAMPLE DATE: 04/07/79
TIME: START 19:15 FINISH 20:15
SAMPLE #: GM - 1 - 004
SAMPLE VOLUME: 700 ml
GAS VOLUME: 45.702 A SCF
SAMPLING RATE: .762 A CFM
ANALYSIS DATE: _____
RESULTS: 3.2 ppm

POLLUTANT: ORGANIC ACID

SOURCE: GM ELPO STACK # 2
SAMPLE DATE: 04/07/79
TIME: START 20:07 FINISH 21:07
SAMPLE #: GM - 2 - 005
SAMPLE VOLUME: 678 ml
GAS VOLUME: 26.396 A SCF
SAMPLING RATE: .440 A CFM
ANALYSIS DATE: _____
RESULTS: 1.5 ppm

POLLUTANT: ALDEHYDE

SOURCE: GM ELPO STACK # 3
SAMPLE DATE: 04/07/79
TIME: START 10:25 FINISH 11:25
SAMPLE #: GM - 3 - 006
SAMPLE VOLUME: 770 ml
GAS VOLUME: 44.251 SCF
SAMPLING RATE: .738 CFM
ANALYSIS DATE: _____
RESULTS: 9.1

POLLUTANT: ALDEHYDE

SOURCE: GM ELPO STACK # 3

SAMPLE DATE: 05/07/79

TIME: START 13:10 FINISH 14:10

SAMPLE # GM - 3 - 007

SAMPLE VOLUME: 780 ml

GAS VOLUME: 44.063 A SCF

SAMPLING RATE: .734 A CFM

ANALYSIS DATE: _____

RESULTS: 7.7

POLLUTANT: ORGANIC ACID

SOURCE: GM ELPO STACK # 2

SAMPLE DATE: 05/07/79

TIME: START 13.05 FINISH 14.05

SAMPLE # GM - 2 - 008

SAMPLE VOLUME: 710 ml

GAS VOLUME: 26.889 A SCF

SAMPLING RATE: .448 A CFM

ANALYSIS DATE: _____

RESULTS: 90

POLLUTANT: ALDEHYDE

SOURCE: GM ELPO STACK # 2

SAMPLE DATE: 05/07/79

TIME: START 18:35 FINISH 19:35

SAMPLE # GM - 2 - 009

SAMPLE VOLUME: 750 ml

GAS VOLUME: 46.166 A SCF

SAMPLING RATE: .769 A CFM

ANALYSIS DATE: _____

RESULTS: 13.2

POLLUTANT: ORGANIC ACID

SOURCE: GM-ELPO STACK # 3

SAMPLE DATE: 05/07/79

TIME: START 18:42 FINISH 19:42

SAMPLE # GM-3-010

SAMPLE VOLUME: 730 ml

GAS VOLUME: 27.055 A SCF

SAMPLING RATE: .434 A CFM

ANALYSIS DATE: _____

RESULTS: 79

POLLUTANT: ALDEHYDE

SOURCE: GM ELPO STACK # 2

SAMPLE DATE: 05/07/79

TIME: START 20:06 FINISH 21:13

SAMPLE # GM-2-011

SAMPLE VOLUME: 645 ml

GAS VOLUME: 49.743 A SCF

SAMPLING RATE: .777 A CFM

ANALYSIS DATE: _____

RESULTS: 13.7

POLLUTANT: ORGANIC ACID

SOURCE: GM ELPO STACK # 3

SAMPLE DATE: 05/07/79

TIME: START 20:27 FINISH 21:27

SAMPLE # GM-3-012

SAMPLE VOLUME: 690 ml

GAS VOLUME: 25.89 A SCF

SAMPLING RATE: .431 A CFM

ANALYSIS DATE: _____

RESULTS: 73

SOURCE:

GM ELPO STACK # 4

POLLUTANT:
ALDEHYDE

SAMPLE DATE:

06/07/79

TIME: START

9:30

FINISH

10:30

SAMPLE #

GM-4-013

SAMPLE VOLUME:

700

ml

GAS VOLUME:

47.96

A SCF

SAMPLING RATE:

.799

A CFM

ANALYSIS DATE:

RESULTS:

2.8

SOURCE:

POLLUTANT: ORGANIC ACID

GM ELPO STACK # 1

SAMPLE DATE:

06/07/79

TIME: START

9:37

FINISH

10:37

SAMPLE #

GM-1-014

SAMPLE VOLUME:

774

ml

GAS VOLUME:

25.487

A SCF

SAMPLING RATE:

.425

A CFM

ANALYSIS DATE:

RESULTS:

82

POLLUTANT: ORGANIC ACID

SOURCE:

GM ELPO STACK # 1

SAMPLE DATE:

06/07/79

TIME: START

13:15

FINISH

14:15

SAMPLE #

GM-1-015

SAMPLE VOLUME:

652

ml

GAS VOLUME:

24.447

A SCF

SAMPLING RATE:

.407

A CFM

ANALYSIS DATE:

RESULTS:

75

POLLUTANT
ALDEHYDE

SOURCE: GMELPO STACK # 4
SAMPLE DATE: 06/07/79
TIME: START 13:25 FINISH 14:25
SAMPLE #: GM-4-016
SAMPLE VOLUME: 6.46 ml
GAS VOLUME: 48.52 SCF
SAMPLING RATE: .809 A CFM
ANALYSIS DATE: _____
RESULTS: 2.6.

BLANK:

SOURCE: NaOH SOLUTION (5%)
SAMPLE DATE: 06/07/79
TIME: START _____ FINISH _____
SAMPLE #: 17
SAMPLE VOLUME: ~100 ml
GAS VOLUME: _____ SCF
SAMPLING RATE: _____ CFM
ANALYSIS DATE: _____
RESULTS: $V_b =$ 0.16 ml.

BLANK:

SOURCE: NaOH SOLUTION (5%)
SAMPLE DATE: 05/07/79
TIME: START _____ FINISH _____
SAMPLE #: 18
SAMPLE VOLUME: ~100 ml
GAS VOLUME: _____ SCF
SAMPLING RATE: _____ CFM
ANALYSIS DATE: _____
RESULTS: 0.20 ml

SOURCE: BLANK; NaHSO₃ SOLUTION (1%)
 SAMPLE DATE: 05/07/79
 TIME: START _____ FINISH _____
 SAMPLE # 19
 SAMPLE VOLUME: ~100 ml
 GAS VOLUME: _____ SCF
 SAMPLING RATE: _____ CFM
 ANALYSIS DATE: _____
 RESULTS: $V_b = 0.11 \text{ ml}$

SOURCE: BLANK; NaHSO₃ SOLUTION (1%)
 SAMPLE DATE: 29/06/79
 TIME: START _____ FINISH _____
 SAMPLE # 20
 SAMPLE VOLUME: ~100 ml
 GAS VOLUME: _____ SCF
 SAMPLING RATE: _____ CFM
 ANALYSIS DATE: _____
 RESULTS: $V_b = 0.10 \text{ ml}$

SOURCE: BLANK; NaOH SOLUTION (5%)
 SAMPLE DATE: 29/06/79
 TIME: START _____ FINISH _____
 SAMPLE # 21
 SAMPLE VOLUME: ~100 ml
 GAS VOLUME: _____ SCF
 SAMPLING RATE: _____ CFM
 ANALYSIS DATE: _____
 RESULTS: $V_b = 0.70 \text{ ml}$

APPENDIX C

Odour Sample Data

ODOUR SAMPLES

SAMPLE # 1

SOURCE Stack 'Bar'

SAMPLE DATE 3-7-79

TIME: START 10:35 FINISH 10:41

PRE-DILUTION RATIO no dilution

EVALUATION DATE July 4

ED₅₀ 450

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_S	Flowrate	ΔH_D	Flowrate	
.05" H_2O	0.538 $\frac{ft^3}{min}$	0	0	1:0

ODOUR SAMPLES

SAMPLE # 2

SOURCE stack ' Larry

SAMPLE DATE 3-7-79

TIME: START 10:49 FINISH 10:55

PRE-DILUTION RATIO none

EVALUATION DATE July 4

ED₅₀ 650

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
.05	0.538 0.538	0	0	1:0

ODOUR SAMPLES

SAMPLE #

SOURCE

SAMPLE DATE

TIME: START

PRE-DILUTION RATIO

EVALUATION DATE

ED 50

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.05	0.512	0.40	2.415	

ODOUR SAMPLES

SAMPLE #

SOURCE

SAMPLE DATE

TIME: START

FINISH

PRE-DILUTION RATIO

EVALUATION DATE

ED 50

$$5.7 \times 850$$
$$= 4850.$$

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
$\Delta \cdot H_s$	Flowrate	ΔH_D	Flowrate	
005	512	4	2.415	15

ODOUR SAMPLES

SAMPLE # 1

SOURCE

SAMPLE DATE July 4/79

TIME: START 8:56 FINISH 9:02

PRE-DILUTION RATIO _____

EVALUATION DATE July 5.

ED 50 260

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.5"	0.538	0	0	1:0

ODOUR SAMPLES

SAMPLE # 2

SOURCE 1

SAMPLE DATE July 4/79

TIME: START 9:15 FINISH _____

PRE-DILUTION RATIO NO DILUTION

EVALUATION DATE July 5

ED₅₀ 170

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.5"	0.530 very low ~ .2 cfm	0	0	1:0

ODOUR SAMPLES

SAMPLE #

3

SOURCE

1

SAMPLE DATE

July 4/79

TIME: START

9:57

FINISH

10:07

PRE-DILUTION RATIO

1:4.7

EVALUATION DATE

July 5.

ED 50

$$5.7 \times 280 = 1600$$

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.5"	0.512	0.40	2.415	1: 6 4.7

ODOUR SAMPLES

SAMPLE #

SOURCE

SAMPLE DATE

TIME: START

FINISH

PRE-DILUTION RATIO

EVALUATION DATE

ED 50

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.5"	0.512	0.40	2.415	1:4.7

ODOUR SAMPLES

SAMPLE #

SOURCE

SAMPLE DATE

TIME: START

PRE-DILUTION RATIO

EVALUATION DATE

ED 50

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.05	0.512 0.512	0	0	1:0

ODOUR SAMPLES

SAMPLE # 2

SOURCE 3

SAMPLE DATE July 4 / 79.

TIME: START 11:24 FINISH 1:29

PRE-DILUTION RATIO no dilution

EVALUATION DATE July 5

ED₅₀ 200

[illegible]

ODOUR SAMPLES

SAMPLE # 3

SOURCE 3

SAMPLE DATE July 4 / 79

TIME: START 11:37 ^{11:41-11:43 break} FINISH 11:48

PRE-DILUTION RATIO 1:4.7

EVALUATION DATE July 5.

ED₅₀ 5.7 X 200 = 1140

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.5" 0.05"	0.523 0.512	0.40 0.40	2.413 2.415	1:4.7 1:4.7

ODOUR SAMPLES

SAMPLE # 4

SOURCE 3

SAMPLE DATE July 5/79

TIME: START 8:06 FINISH 8:17

PRE-DILUTION RATIO 1:4.7

EVALUATION DATE July 6

ED₅₀ 5.7 X 450 = 2570

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.05 0.05"	0.512 0.512	0.40 0.40	2.415 2.415	1:4.7 1:4.7

ODOUR SAMPLES

SAMPLE # 1
SOURCE 4
SAMPLE DATE JULY 5 / 79
TIME: START 10:02 FINISH 10:15
PRE-DILUTION RATIO no dilution
EVALUATION DATE July 6
ED₅₀ ~~500~~ 300

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
C.C.S." "	C.5/2	C	C	1:0

ODOUR SAMPLES

SAMPLE #

2.

SOURCE

4

SAMPLE DATE

July 5/71

TIME: START

10:29

FINISH

10.37

PRE-DILUTION RATIO

NO ALTERN

EVALUATION DATE

July 6

ED 50

320

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.05"	0.512	C	C	1:C

ODOUR SAMPLES

SAMPLE #

SOURCE

SAMPLE DATE

TIME: START

FINISH

PRE-DILUTION RATIO

EVALUATION DATE

ED 50

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.65 0.095	0.512 0.653	0.40 0.30	2.415 2.167	1:4.7 1:3.3

ODOUR SAMPLES

SAMPLE #

SOURCE

SAMPLE DATE

TIME: START

FINISH

PRE-DILUTION RATIO

EVALUATION DATE

ED 50

SAMPLE LINE		DILUTION LINE		DILUTION RATIO
ΔH_s	Flowrate	ΔH_D	Flowrate	
0.05 "	0.512	0.40	2.415	1.4.7
0.095"	0.653	0.30	2.167	1.3.3



96936000009414